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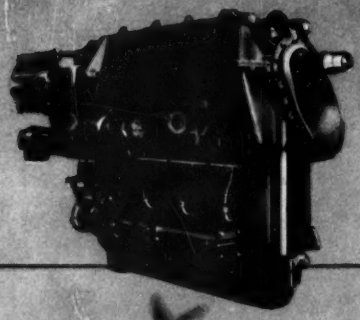

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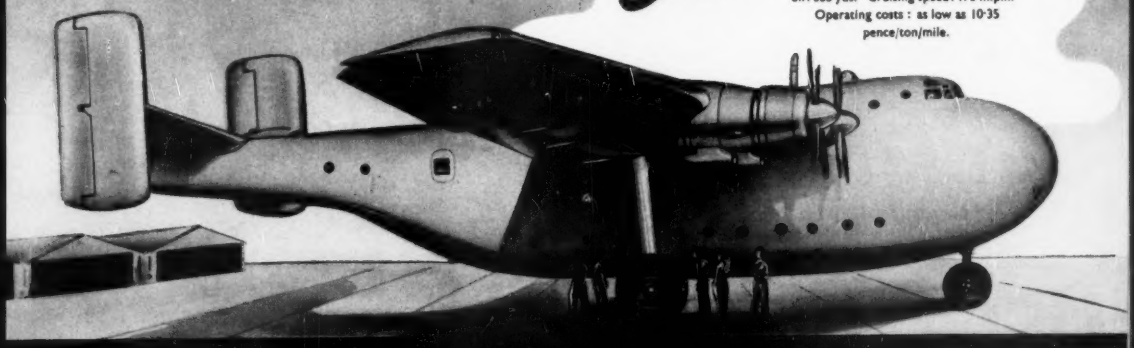

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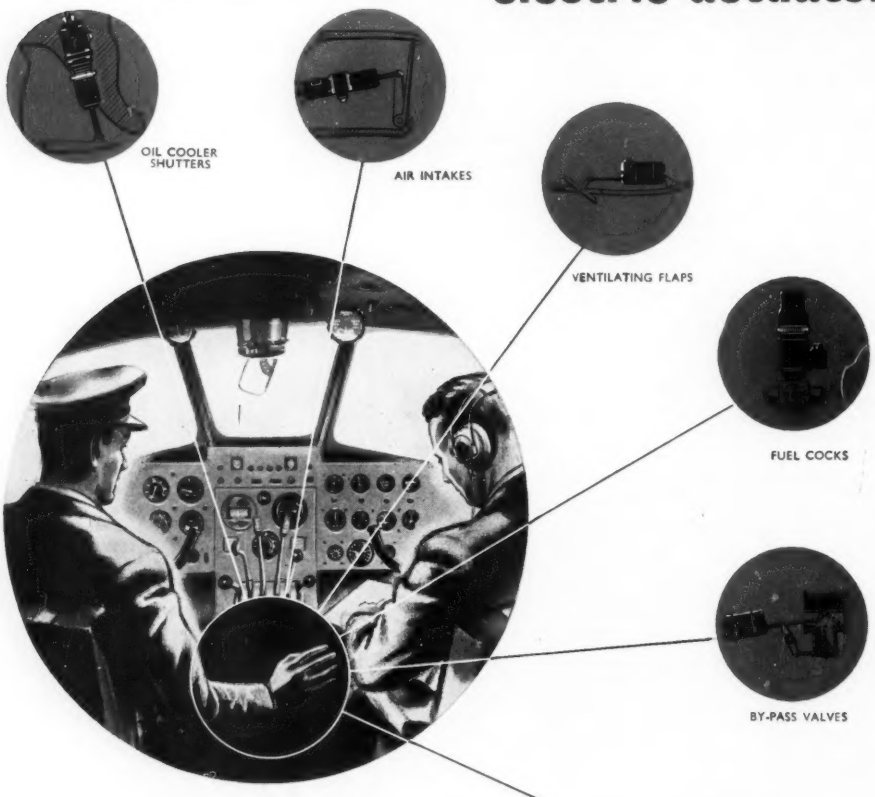

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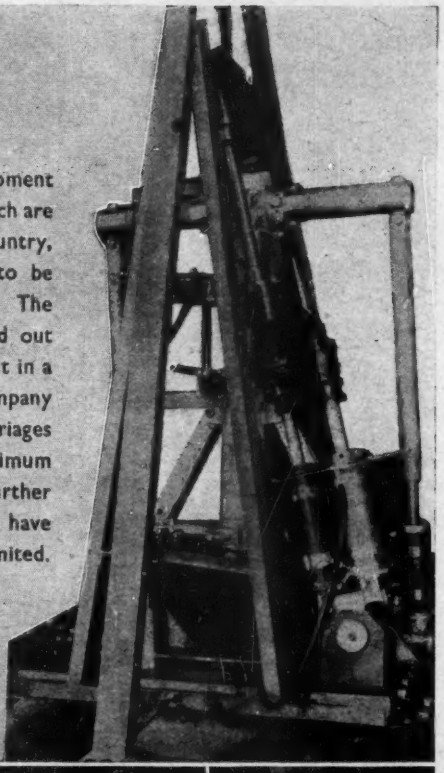

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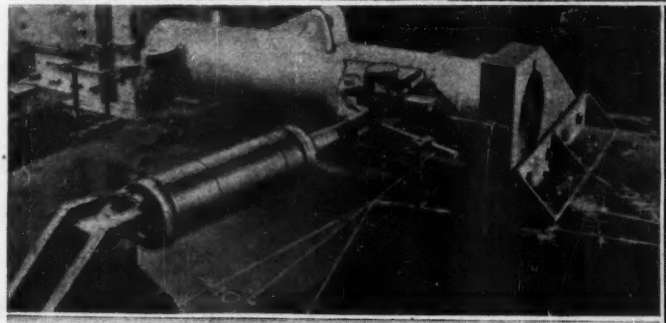

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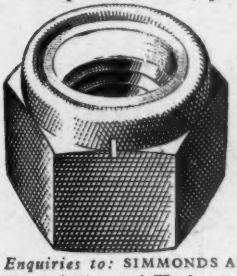

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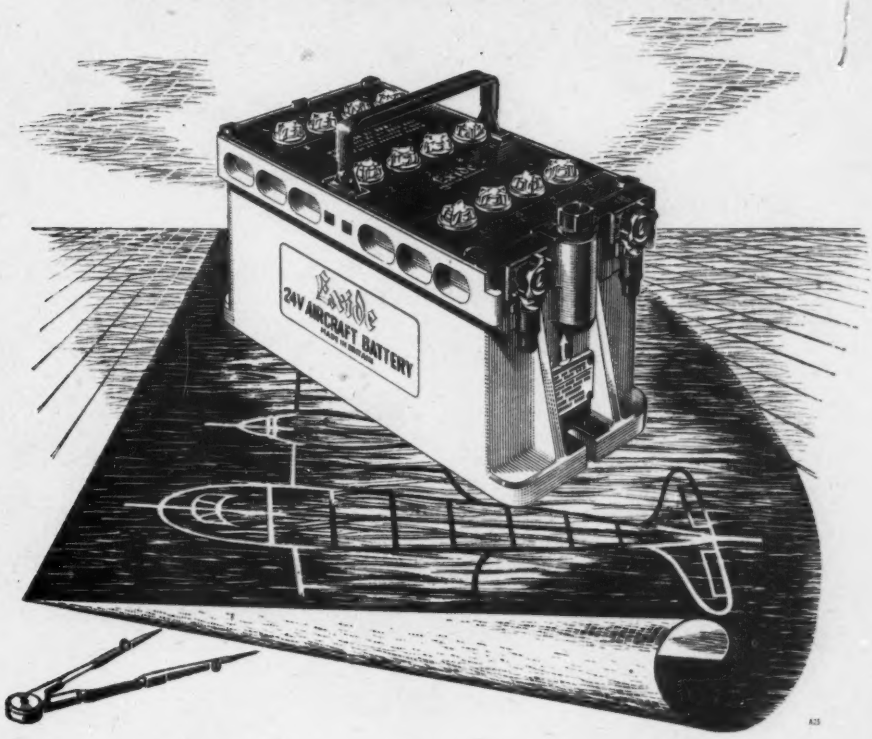

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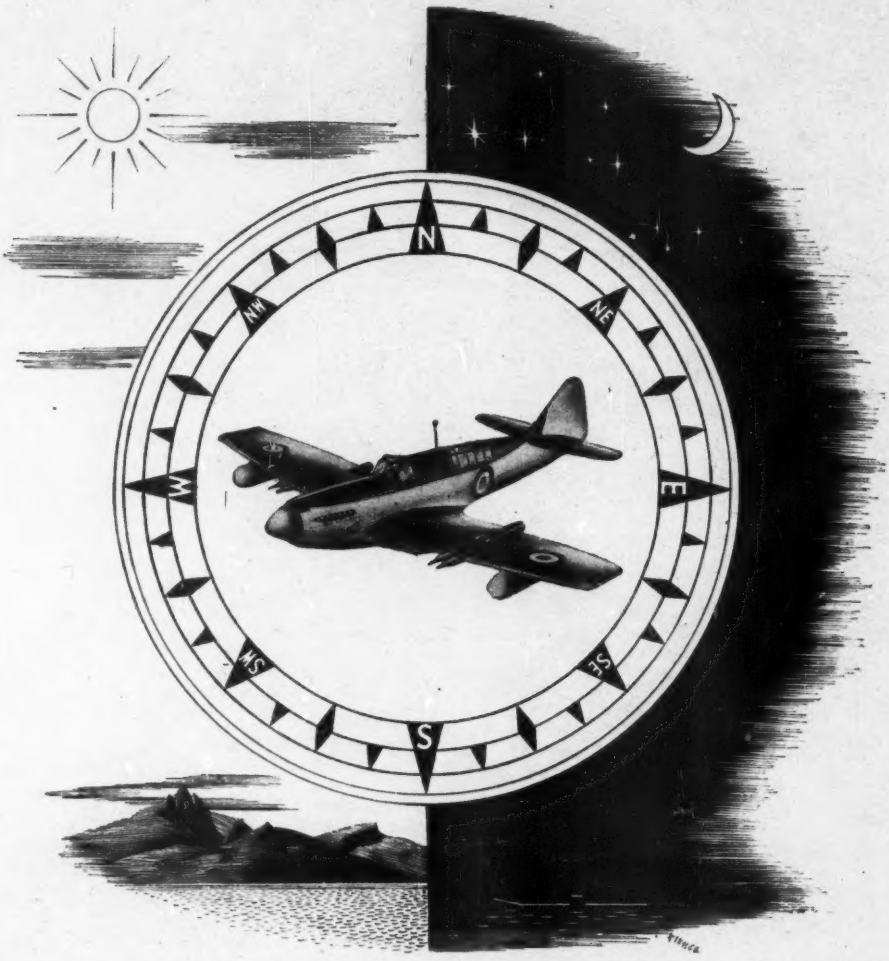

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Helicopter Requirements

"WHEN are we going to have family helicopters to land in the back garden?" "Why don't we have helicopter buses from London Airport to Charing Cross?" Such questions are asked frequently, but to provide convincing, non-technical, one-sentence answers is almost impossible. The second, certainly, relates to something capable of realization within a few years; but the first postulates an objective that may never be attained.

It is forty-three years since a man—Louis Bréguet—lifted himself with a helicopter, but during most of the intervening period comparatively little effort or money has been expended upon rotary-wing developments; thus machines of this class have fallen far behind those of the orthodox, fixed-wing type. Only recently has the usefulness of the helicopter been appreciated by military authorities or, perhaps more correctly, has the helicopter reached a stage of practicality which permits its particular qualities to be used to advantage. Helicopters cannot yet be described as being in general use in any country, although the Americans and ourselves are exploiting their unique flying characteristics to an ever-increasing extent, for mail, rescue and agricultural purposes.

Knowledge of the design, construction and controls of helicopters is very incomplete, even among those in the aircraft industry and flying Services, and it is for this reason that we print this week (pages 17-20) the first of a series of articles by a pioneer and leading authority on these aircraft. An understanding of his explanations will provide a firm foundation and background for studying the much-accelerated development programmes for rotating-wing machines, and enable the reader better to assess the probable importance of such aircraft in the next decade. Undoubtedly the helicopter is on the verge of becoming a powerful factor in both military and commercial aviation. But first the right machines must be produced, and it is upon this task that the American and—to a lesser extent—the British industries are engaged.

In simple terms, the right machine for commercial passenger services is in the first instance a twin-engined two-rotor design capable of carrying in safety, over built-up areas, a dozen or twenty people on short inter-city and metropolitan routes. Were such a helicopter available now, plans for introducing services would certainly be more advanced. In opposition to British—particularly B.E.A.—views, are those of America's experts, Messrs. Sikorsky and Piasecki, who have stated that "certification of passenger helicopter services should not be delayed until twin-engined ships are available."

For military duties the requirements—and there are several—are not quite so clear-cut. Two distinguished officers, Maj.-Gen. R. H. Bower, Director of Land/Air Warfare, speaking before the Helicopter Association of Great Britain (see *Flight*, September 28th) and Vice-Admiral M. J. Mansergh, Fifth Sea Lord and Deputy Chief of Naval Staff (Air), lecturing before the R.U.S.I. (*Flight*, November 16th), have given a good overall picture of the probable requirements. The Army needs a jungle, arctic and sea-rescue helicopter—probably a four-seater; a load carrier to the duties of which might be added, on occasions, special assault; a small A.O.P. machine; and probably a medium-sized general-purpose type as well. The Navy might also head the list with a rescue helicopter, but additionally they need one for close-in anti-submarine duties, while either of these machines might double in a communications (ship-to-ship and ship-to-shore) and general-purpose role.

Of the future, *Flight* had something to say in October: "Chiefly we lack experimental machines with jet-driven rotors. In the jet drive lie the solutions to major problems—those of torque reaction on single-rotor helicopters, drive transmission, and power-plant weight and complication. . . . News of definite British jet-rotor developments is awaited with some impatience, particularly as gearing problems may delay, if not debar, existing gas turbines in their application to helicopters."

In addition to the tendency towards increased size of prototypes the past year has seen notable advances in omniphibious landing-gear, stability for hands-off flight, and automatic-pilot control for all flying conditions, including hovering.

LABUAN AIRPORT

New Passenger Buildings at a Service-cum-Civil Base in North Borneo

The control tower forms part of the main airport-building, in which passenger-reception and customs are also housed.

FROM the time it was ceded to Great Britain in 1846, by the Sultan of Brunei, the island of Labuan, North Borneo, has been noted for its excellent harbour facilities. In accord with present-day requirements, the same progressive outlook is now evident in the provision of Labuan's new airport facilities, on the buildings of which over 300,000 Malayan dollars have recently been spent.

The new buildings were opened for use in the middle of last month. They include modern passenger-handling and Customs rooms, and the control tower forms the central portion of the main airport-building. Covered gangways lead to the sleeping accommodation, which is divided into a number of single and double rooms, all tastefully and comfortably furnished.

Part of the airfield was built by the Japanese during their occupation of the island in 1942. After liberation of the island by the Australian 9th Division in 1945, Japanese prisoners of war were put to work and there is now a runway of 2,000 yards, capable of taking aircraft up to the weight of Hastings and Skymasters. The runway surface is of crushed coral and it has been found necessary to flood it periodically with sea water, otherwise the whole area disintegrates; fresh water will not serve the same purpose.

A glance at a map shows that Labuan is the by-pass between Singapore and Japan if Saigon (Indo-China) and Hong Kong should be out of commission. Its strategic value is very high.

At present the airfield handles between 80 and 100 air movements a month. Qantas, K.L.M., Cathay Pacific and Malayan Airways all use the airport and Garuda Indonesian expect soon to try a proving flight. Nearby are facilities for handling and refuelling up to four flying boats. The Royal Air Force is a joint user of Labuan in that the airport houses a radio navigation station, at present commanded by F/O. G. Meyrick. A sergeant and 15 airmen complete this happy detachment. As amusements the men have football—not played in bare feet, as by the Labuans—a cinema show twice a week, and a model-aircraft club, while the A.O.C. has lent the station a sailing boat.

F/O. G. Meyrick, who commands the R.A.F. radio navigation unit in Labuan.

Illustrated with "Flight" Photographs

The spacious layout of the new buildings is emphasized when seen from the air. An open-sided but roofed corridor leads from the airport building to the passengers' accommodation in the rear.

Top left: In the background can be seen the old atap (native-built) customs shed which is now being replaced. Left: The R.A.F. Transit Camp. Above: A glimpse into one of the comfortable bedrooms in the new buildings. The beds are enclosed in mosquito netting.

There is also a club in the town, run by the twenty or so Europeans who live there.

The R.A.F. detachment is revictualled once a month by Dakota, and at suitable periods of the year Mosquito 34s from the Far East P.R. squadrons use Labuan as a centre for air survey work. Refuelling facilities are maintained by the Shell organization for both military and civil aircraft passing through.

In the jungle surrounding the airfield crashed Japanese aircraft are still being found. The natives retrieve these wrecks for their scrap-metal value. It is surprising how well the aluminium structure of these aircraft has stood up to the destructive effects of time and tropical weather. Judging by the condition of a "Lily" bomber, recently found within 200 yards of the airfield perimeter, it might have been shot down only the day previously—yet it must have been there for over five years.

[This brief article on a little known but well organized overseas airport is by John Yoxall, Art Editor of "Flight." He visited North Borneo last month during a flight to Singapore in Transport Command aircraft, and he is now to contribute a special series of articles on the work of the Far East Air Force: the first of these will appear next week.]

C. of A. FOR APOLLO

A WELCOME New Year's gift for Armstrong Whitworth Aircraft, Ltd., was the announcement made last Monday, January 1st, that the Apollo has been granted a limited-category C. of A. This will, of course, permit it to carry non-fare-paying passengers.

The prototype Apollo, which is designed as a general-purpose transport with normal accommodation for 24-31 passengers on short- and medium-range duties, first flew on April 10th, 1949, at a take-off weight of 29,000 lb. Present normal all-up weight is 45,000 lb. A modified fin and rudder have been fitted since the prototype's first appearance.

JETS FOR SCOTTISH AUXILIARIES

THE first Scottish Auxiliary Squadron to be re-equipped with jet aircraft is No. 602 (City of Glasgow), whose Vampire 5s were due to be delivered last week-end. The squadron has been operating at Renfrew for the past 18 months while the runways at their home base, Abbotsinch, were being lengthened for the new aircraft. S/L. H. M. Steven, D.S.O., is No. 602's commanding officer

EMPIRE AIR MAIL HISTORY

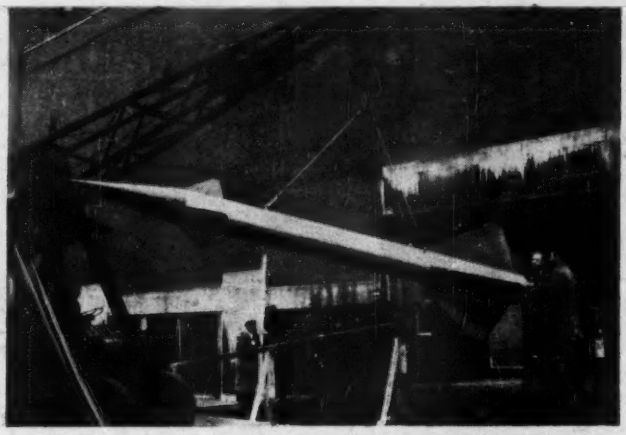
"Imperial Airways (and Subsidiary Companies)—a History and Priced Check List of the Empire Air Mails." Compiled by N. C. Baldwin. Francis J. Field, Ltd., Sutton Coldfield. Price 7s 6d.

THIS informative and well-illustrated little publication, on 80 pages of art paper, should be of interest not only to philatelists but to those many enthusiasts who collect historical data on aircraft and airlines. It covers the early history of its subject in considerable detail, for very many of the pioneer routes of Imperial Airways and their subsidiaries were opened with combined mail and passenger services, while some were inaugurated for mail-carrying only as a preliminary to passenger operations.

The period reviewed is from 1927, when Imperials took over the Cairo-Baghdad service operated by the R.A.F., up to the absorption of the airline into B.O.A.C. in 1940.

A remarkable feature of the history is the number of occasions on which mail was recovered from aircraft which had met with misfortune. In such cases, if the covers had been damaged, an explanatory cachet was usually added; such additions add to the value of the cover from the collector's viewpoint.

HERE and THERE



"LIGHT BLUE TOUCH PAPER . . . ." Arriving at the New Agricultural Hall for the School-boys' Exhibition, which runs until January 13th, is this British experimental rocket—20ft long and of 17in diameter. Ministry of Supply and R.A.F. exhibits are well patronized.

Venoms by Bristol

DE HAVILLAND'S own production of Venom intercepters is to be supplemented by the Bristol Aeroplane Company, which is undertaking Venom manufacture at the request of the Ministry of Supply. The Bristol company's aircraft division is also engaged on long-term development of guided missiles; and the engine division, it was recently announced, is to build Rolls-Royce Avon turbojets to meet increased defence requirements. Employment in Bristol's Aircraft Division has been increasing for some time past, and the new programme will, of course, mean its maintenance at a high level.

Hydrofin Claims

ARRIVING in New York, Mr. Christopher Hook, the British inventor of the Hydrofin airscrew-driven craft, stated that the Admiralty had begun to take some interest in the anti-submarine possibilities of the Hydrofin. "It cannot be torpedoed," said Mr. Hook. He claimed a speed of 50 m.p.h. and said that single-seater models would cost about £350.

"Met" Aircraft Lost

A HALIFAX of the R.A.F., engaged on a meteorological flight and carrying a crew of eight, was seen by members of the crew of the Fleetwood trawler *Flanders* to crash into the sea about 15 miles south-west of the island of Barra, in the Outer Hebrides, on December 29th. Wreckage was found and a B.E.A. Dakota, flying from Stornoway to Glasgow, diverted to circle the area until relieved by an R.A.F. machine. Capt. A. Hadley, pilot of the Dakota, reported seeing an R.A.F. dinghy half overturned.

Canuck and Orenda Production

SIR ROY DOBSON, president of Avro Canada, has announced that the company is going ahead immediately with new assembly lines for the CF-100 twin-jet heavy fighter and the Orenda axial-flow turbojet. "The Canuck," said Sir Roy, "is now recognized by the Royal Canadian Air Force as the front-line fighter for over-the-Pole warfare." The Orenda has been fully tested in the F-86 Sabre fighter and may later be used to power Canadian-built Sabres.

Journalist Honoured

AMONG the names in the New Year Honours List is that of Mr. R. W. Haddon, C.B.E., upon whom a knighthood is conferred. Mr. Haddon is deputy chairman of Associated Iliffe Press (whose control of 33 journals—among which is included *Flight*—makes it the largest trade Press group in the world) and a director of various of its subsidiary companies. As managing editor of *Farmer and Stock-Breeder*, and as chairman of the Ministry of Agriculture's Publicity Advisory Committee, he has had much to do with the country's food production; he was, incidentally, responsible for the famous slogan "Dig for Victory." From 1940 to 1946 he was chairman of the Red Cross Agriculture Fund, which raised approximately £8½ million.

Gliding Record Claim

MR. MARTIN WARNER, of the Sydney Soaring Club, claims an Empire glider height record of more than 26,000ft—4,662ft higher than the British record. A new world record of 42,000ft was claimed last Saturday by an American, Mr. William S. Ivans.

Meteors for Japan

THE resident minister for Australia, Mr. E. J. Harrison, announced on December 29th that a number of officers and airmen of the Royal Australian Air Force had arrived in Great Britain by air from Australia to study the maintenance and operation of the Meteors lately acquired by the R.A.A.F. After completion of their courses, said Mr. Harrison, they will go to Japan, where the R.A.A.F. squadron to be re-equipped is based. As already reported, the Meteors are Mk. 8s, of the type now being delivered to R.A.F. squadrons.

Smiling Through

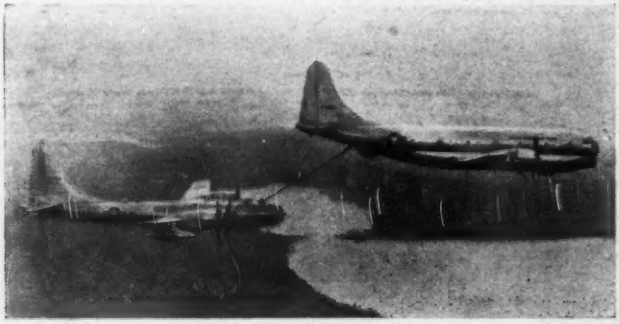
TOWER: "Stratocruiser KZ—you are landing downwind on the wrong runway."

Pilot: "Roger. You can't be too careful."

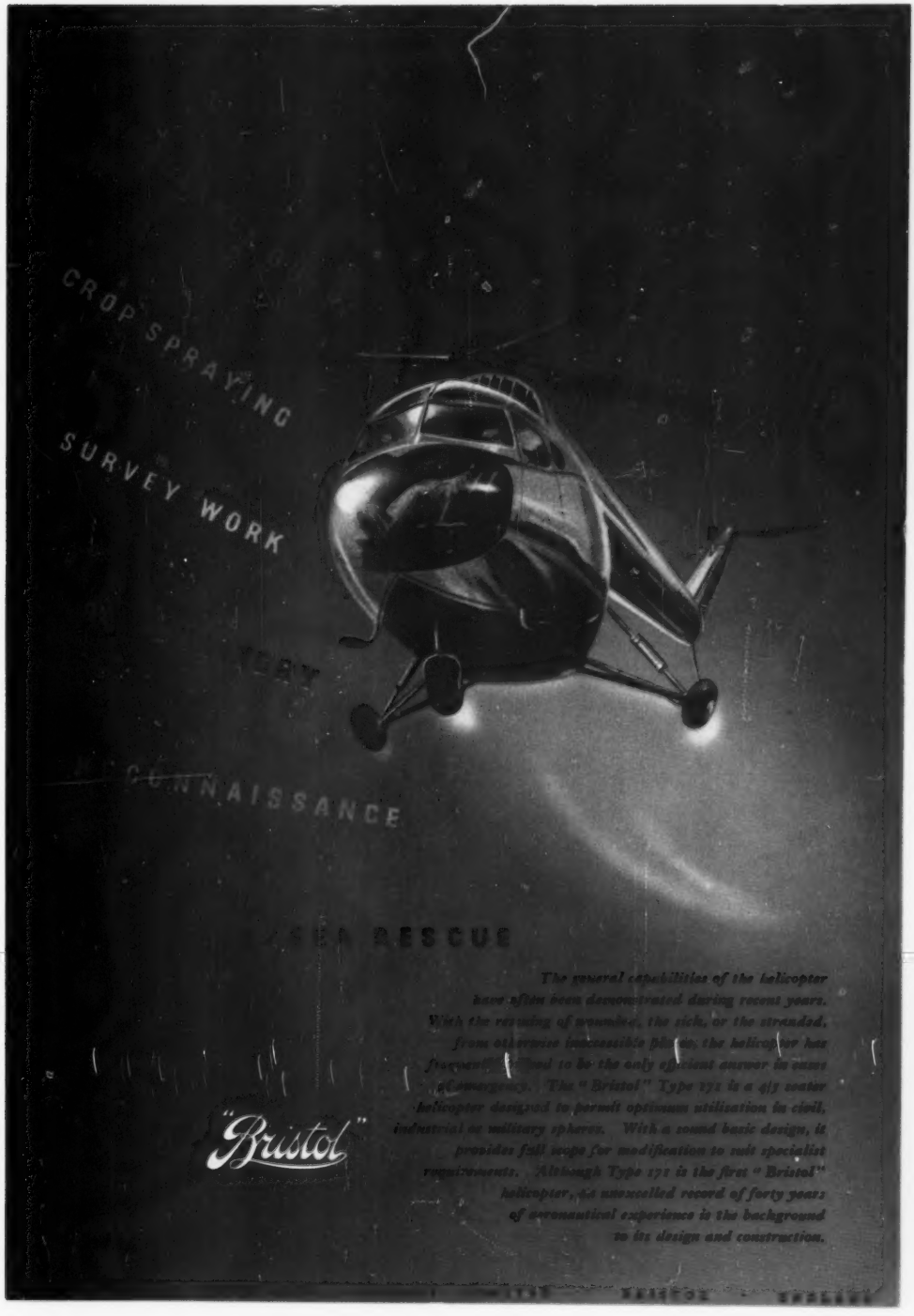
—from the *de Havilland Gazette*, which, among a number of "Christmas specials" that have reached us during recent weeks, deserves special mention for its sustained high level of dry wit with a genuinely aeronautical flavour.

Invaders *versus* Rebels

AMERICA is sending 30 Douglas B-26 Invader light bombers to the French forces fighting the Vietminh rebels in Indo-China. Until they received 40 Grumman Hellcat fighter-bombers last



STRATOFREIGHTER TANKER: Refuelling a B-50D Superfortress by the Boeing "flying boom" method is a KC-97A Stratofreighter, adopted as a tanker. The standard Stratofreighter carries 135 fully equipped troops, 83 litter patients with medical supplies and attendants, or up to 68,000lb of freight.



"Bristol"

The general capabilities of the helicopter have often been demonstrated during recent years. With the rescuing of wounded, the sick, or the stranded, from otherwise inaccessible places, the helicopter has frequently proved to be the only efficient answer in many emergencies. The "Bristol" Type 171 is a 4/5 seater helicopter designed to permit optimum utilisation in civil, industrial or military spheres. With a sound basic design, it provides full scope for modification to suit specialist requirements. Although Type 171 is the first "Bristol" helicopter, it has unrivalled record of forty years of aeronautical experience in the background to its design and construction.

THE BRISTOL AEROPLANE

Eighteen years ago the magnificent Sydney Harbour Bridge provided a vital new communication link. Today, a new era in travel has arrived with the introduction into airline operation of the turbo-prop Viscount — the ideal choice for medium-range operation on any route and in any climate.
VICKERS VISCOUNT
FOUR ROLLS-ROYCE DART PROPELLER TURBINES

HERE AND THERE . . .

October, most of the French air attacks on the rebels were being made with Junkers 52 transports.

All-weather Defence

TWENTY-FOUR-HOUR watch over New York and other east coast cities is now being maintained by Lockheed F-94 all-weather fighters of the 52nd Fighter Wing, U.S.A.F., stationed at Fort Dix, New Jersey. The F-94 is a two-seat, radar-equipped version of the F-80 Shooting Star, and is equipped with an afterburner for increased speed on take-off and climb or in combat.

Helicopter Forecast

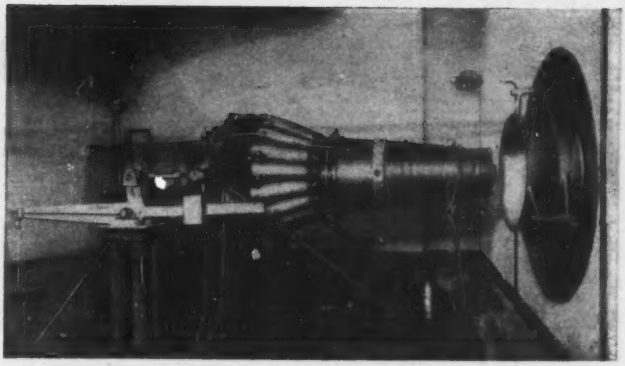
SPEAKING before the Institute of Aeronautical Sciences recently, Mr. Igor Sikorsky forecast the eventual predominance of single-rotor helicopters. He likened their greater aerodynamic efficiency to that of the monoplane, compared with the biplane and triplane. There was no limit in sight to helicopter-size: machines of 50-100,000lb could be constructed in the near future.

Lowering the Curtain

FOLLOWING the recent recriminations over airline operations, Czechoslovakia is now reported to have banned the use of Service or diplomatic aircraft by members of the British, Canadian and American Embassies in Prague. Mr. Ellis Briggs, U.S. Ambassador, was recently refused permission to enter Czechoslovakia in a U.S.A.F. aircraft placed at his disposal, and British and Canadian diplomats were told that it would be better if they did not ask for permission to use military aircraft.

Sabres in the News

NO official statement has been made on recent suggestions that the R.A.F. would receive several hundred North American F-86 Sabres, but the possibility is reported to be "under active consideration." As forecast in *Flight* recently, the Sabre has gone into service with the U.S.A.F. in Korea. December 22nd saw a major clash between Sabres and Mig-15s, when eight of the American fighters met 15-25 Migs. The Sabres were stated to have shot down six of the enemy without suffering loss or damage.



ITALY RE-ARMS : A de Havilland Goblin turbojet on test at the new Fiat experimental establishment at Sangone, Turin. The Fiat concern is to build both Goblins and Ghosts under licence ; Vampires are in production in Italy and, as announced recently, the Venom is also to be built there.

Cause for Concern

ITALY, with a slightly smaller population than the United Kingdom, has more than twice as many private pilots—according to recent statistics compiled by the F.A.I. Switzerland provides an even more striking example of the numerically unhealthy state of private flying in Britain: its private pilots number 6,498, compared with 3,300 here—although our population is ten times greater. The F.A.I. has compiled the following list of numbers of people practising private flying in six countries for which figures were available (the approximate population of each has been added in brackets): United States, 24,000 (148,000,000); Italy, 7,000 (46,000,000); Switzerland, 6,498 (4,600,000); Denmark, 5,875 (4,200,000); the Netherlands, 3,751 (10,000,000); Britain, 3,300 (48,600,000).

NEWS IN BRIEF

A LECTURE on "The Sensory Basis of Bird Navigation" is being delivered at 5 p.m. to-morrow, January 5th, by Mr. G. V. T. Matthews before the Institute of Navigation, at the Royal Geographical Society, Kensington Gore, London, S.W.7.

* * *

For "eminent service to the progress of aeronautical science and to the cause of Franco-American friendship," Mr. Donald W. Douglas, president of the Douglas Aircraft Company, was recently made a Chevalier of the French Legion of Honour. The award was made in Santa Monica by Gen. Murtin, French air attaché in Washington.

Construction of a 25,000 sq ft extension has been started at the Alperton, London, factory of the Glacier Metal Co., Ltd.

* * *

Flight regrets to record the death, which occurred on December 21st, of Mr. M. B. U. Dewar, chairman of British Timken, Ltd.

* * *

Col. L. C. Bingham, general sales manager of Venner Time Switches, Ltd., leaves England on January 16th for a high-speed business tour of India and West and South Africa.

* * *

A booklet entitled *A Comparison of the Flame-Retardant Properties of Plastic-Insulated and Rubber-Insulated Electric Cable* is now available, price 2s 6d, from the British Plastics Federation, 47-48, Piccadilly, London, W.1.

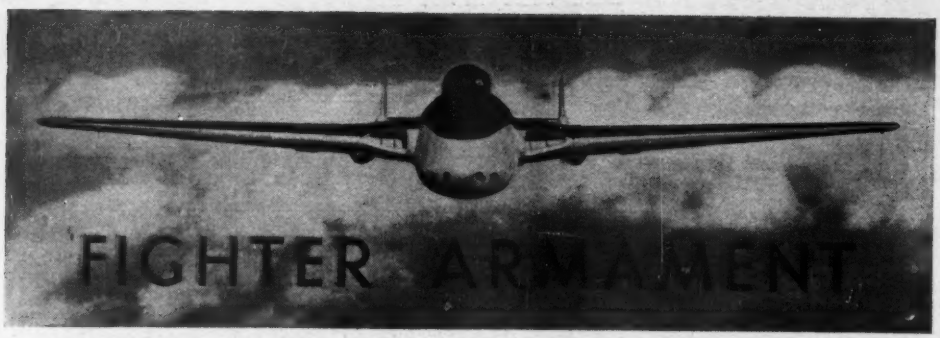
* * *

Bendix Aviation Corporation has appointed Ancillary Developments, Ltd. (managing director, Mr. A. E. Fenn), sole United Kingdom distributors of Pioneer aircraft instruments and spares. A service depot has been opened at Blackbushe under the control of Mr. L. J. Beaumont, production manager of Ancillary Developments' repair organization there.

* * *

A 750-ton British Clearing press recently installed at the Bagington, Coventry, works of Armstrong Whitworth Aircraft, is the largest press of its kind to be used in a British aircraft factory. Of American design, the press has been built under licence by Vickers-Armstrongs at Newcastle. It has already turned out large batches of pressings for Gloster Meteor fuel tanks

AXIALS IN ACTION : America's axial-flow turbojets are being tested in combat for the first time now that the F-84 (Allison J-35) and F-86 (General Electric J-47) are in action over Korea. Shown receiving attention is one of the Korea-based F-86 Sabres which, as reported above, recently scored a success against Mig-15s. The power-unit is remarkably accessible.



FIGHTER ARMAMENT

Part VI: Gun Design and Installation

By A. R. WEYL, A.F.R.Ae.S.

In the first part of this article (August 24th) Mr. Weyl reviewed the history of aircraft armament; in the second (September 21st) he discussed German equipment; in Part III (October 5th) he analysed the respective claims of guns versus rockets; on November 23rd he dealt with the effectiveness of various types of shells and fuses; and in Part V (December 7th) he analysed Luftwaffe combat experiences, particularly with the use of the R.4/M air-to-air rocket missile. In the present instalment he deals with some further aspects of gun design, discusses sights, and shows how installation problems indicate the use of rockets rather than guns in the newest intercepters. A final instalment will deal with rocket design and summarize conclusions.

DURING the First World War the conviction was often expressed that the primary purpose of the fighter aircraft was to achieve air superiority by defeating the enemy's fighters. This led to the interesting but strategically useless *mêlées* so often experienced in 1917-1918. Today it is more generally recognized that the front-line fighter's duty is that of strategic defence, and that the chief targets must always be bombers and observation and/or ground-attack aircraft; the defeat of enemy fighters comes last, as a sort of spare-time job. Hence the choice of armament has to take into account that the least important potential target will be an enemy fighter.

There is no such thing as a "general-purpose" fighter; any attempt to mate the intercepter with a type intended for ground-attack may well produce only a hybrid of little operational use. This applies also to the armament. (It is amazing to what lengths a misguided trend to economy can lead: instead of trying to mix fire and water, so to speak, far more money might be saved by making Service training aircraft less complicated and less lavishly expensive than they have now become.)

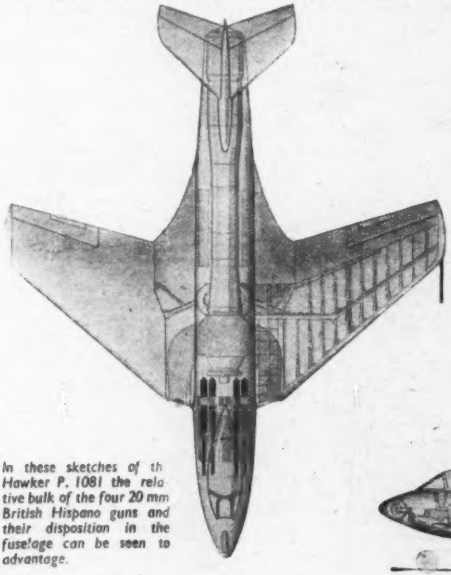
For ground-attack, a high muzzle-velocity is imperative, to give impact penetration at the target and short times of projectile flight.

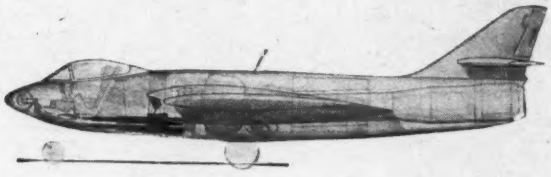
Since the bomber now nearly equals in performance the single-seat intercepter, and because at very high speeds the manœuvrability of the latter is poor (solely on account of the resulting centrifugal accelerations), it might well be argued that large, heavily armed multi-seaters—i.e., "destroyer" jet bombers with long-range armament in lieu of bombs—could improve upon the single-seat intercepter. The idea is intriguing, but the problem of the heavy "battle-plane" *versus* the single-seat fighter has been found insoluble as often as it has been raised. At the end of the last war the Germans also had it in their mind, both for the reasons stated and because of the technical difficulties encountered with the installation of large-calibre, rapid-firing shell-guns.

However, a single-seat intercepter retains better manœuvrability at reduced speeds, and there is always advantage in numbers. Four intercepters should always be tactically more useful than one four-engined "battle-plane." Besides, a sufficiently large fleet of up-to-date "battle planes" might be economically prohibitive.

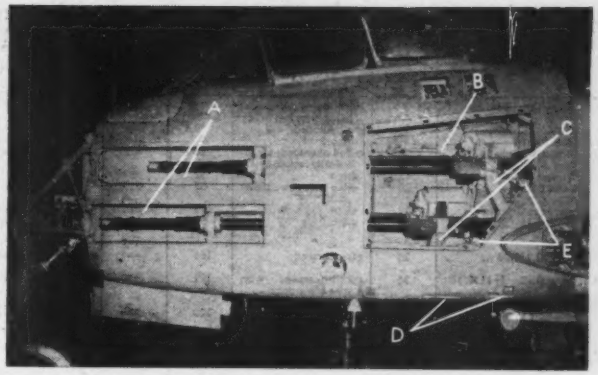
Muzzle Velocity and Rate of Fire.—For air-combat armament, inter-relation must be considered between muzzle velocity, rate of fire and weight and bulk of the gun, on the basis of a given calibre, a given shell, and otherwise identical design features. Admittedly, such comparison is somewhat academic, since a high-velocity gun differs basically from a medium-velocity but quick-firing one: the former type of weapon would preferably be recoil-operated, the latter gas-operated.

Generally, the gas-pressure loader is more sensitive and





In these sketches of the Hawker P. 1081 the relative bulk of the four 20 mm British Hispano guns and their disposition in the fuselage can be seen to advantage.



Two of the four 20 mm guns in the Gloster Meteor. Attention is drawn to (A) the gun barrels, with their blast tubes removed, (B) pneumatic cocking valves, (C) link chutes, (D) case chutes, (E) rear mountings and adjustors.

is considered less reliable, due to the risk of mechanical seizure caused by solid residues in the powder gases; but it is lighter and will normally allow a high rate of fire. German experts hold the view that the gas-operated airborne gun deserves preference for all purposes because of its low weight and because of the smaller number of moving parts; and they consider as exceptional the mass-locking system preferred in the case of the M.K.108 and M.K.112 weapons.

Rate of fire is directly related to muzzle velocity. On our assumptions, the greater propellant charge needed for high muzzle-velocity demands a longer cartridge case, and, consequently, increased stroke of the breech-block and a longer breech; also, a longer barrel is needed, and the recoil is higher. High muzzle-velocity, therefore, increases the reciprocating masses and thus slows the rate of fire. In addition, the gun with the higher muzzle-velocity is longer and heavier; the larger ammunition requires more stowage space and is heavier; and a more substantial mounting is needed.

For a 20 mm aircraft shell-gun (with mechanically locked breech and recoil-operated mechanism), a 50 per cent increase in muzzle velocity reduces the shell's time of flight over 1,000 yards by 20 per cent, while the trajectory is flatter and the impact penetration greater. But this is achieved at the cost of a gun weighing not less than two-and-a-half times as much, of twice the length, and firing at half the speed. The cartridge is longer by 44 per cent.

In general, the trend in air combat is to rely on moderate muzzle velocities. With fixed-gun installations, the flying speed adds to the muzzle velocity; as modern intercepters have high speeds, especially with power-boost during attack, sufficiently flat trajectories result, particularly at high altitudes. Moreover, a deficient muzzle velocity can be compensated by automatically computing sights. A deficiency in fire density, however, compels us to multiply the weapon installation, and this is usually an unacceptable remedy.

Methods of Use.—Interception can be accomplished by four methods of discharging projectiles:—

(a) *Single shot:* automatically triggered, or guided, or directed.
(b) *Burst:* i.e., a sequence of several projectiles.
(c) *Salvo:* i.e., simultaneous discharge of several projectiles.
(d) *Salvo-burst:* a combination of (b) with (c).

Destruction of the target is effected either by a direct hit (or hits), or by nearby detonation. In the latter case, however, it must be realized that the lethal range of even the very effective German 88 mm Flak shell (with time fuze) was actually less than five yards distance from the target, and that the lethal sphere formed by a detonating 3.7in A.A. shell has a diameter of only about 50 feet, effective during about one-fiftieth of a second.

The alternative between splinter and blast action has been referred to in an earlier instalment of this article. Explosive shrapnel, i.e., the ejection of small, separate explosive missiles from a detonating shell is possible, and was eagerly studied in Germany; but its operational effectiveness has yet to be established.

A modern trend is towards *single-shot action* by means of substantial-sized guided or directed, homing, air-to-air missiles which produce lethal spheres large enough to destroy an enemy even with the aid of proximity fuzes, and which can be discharged over ranges exceeding one mile without proper taking of aim. The operational similarity to the naval torpedo is obvious.

The traditional but by no means obsolete method is action by *salvo-bursts*, from weapon batteries firing at high rate over ranges not exceeding about 1,000 yards. The probability of a hit is not related to the single-round dispersion, i.e., the difference between aiming point and average point of impact; burst-dispersion alone is essential. The former characteristic is more usually found in salvo fire; in bursts, projectiles follow each other and cause departure deflections not present in single-shot fire. Moreover, apart from effects of barrel vibration, etc., the target and the attacker move whilst the actual projectiles are under way. Since a modern bomber easily covers 300 yards during one second, range and bearing are subject to considerable variations.

Salvo fire from rocket batteries offers good prospects for the use of small, supersonic rocket or ramjet missiles. If the nose of the fuselage is available for such "honeycomb" batteries as in the Natter (illustrated in Part V), full benefit can be derived, but with launching devices distributed along a wing the fire-density produced might not be good enough. For supersonic intercepters having automatically triggering sights, salvo fire of rockets should be satisfactory. In such aircraft a prone position of the pilot in the nose of the fuselage might be preferred.

As to *salvo-bursts*, it must first be remembered that the "curve of pursuit" is the shortest path along which an intercepter can get into position to open fire. Fixed-gun installations compel the intercepter to follow something approaching a "ramming course"; thus the axis of the intercepter must point towards the target or, in view of the target's motion during the time of flight of the projectiles, towards the point which the target will reach when the projectiles complete their flight. The "lead" required for the relative movement during projectile flight may be considerable. If the target proffers defensive fire, the curve of pursuit will be adhered to solely during the short interval between taking aim and firing; this may be anything between, say, three and six seconds, and during it the intercepter is helplessly exposed.

Operational experience indicates that, when the target is not fired at from directly aft or whilst moving in the same vertical plane as the intercepter, the probability of hits is much reduced ("lead dispersion"). Angles exceeding 20 deg in flight courses can give prospects of destruction only with the aid of automatically computing (i.e, gyro-monitored) sights. However, in an attack from above or below, at an angle of less than 30 deg, whilst flying on the same course as the target, the latter presents a larger area, and the chances of a hit are greater.

Automatically computing sights (first suggested and experimented with during the First World War, by this country) are a necessity for an intercepter. They must at least provide the angle of deflection (or lead), while automatic ranging, also, is most desirable. All this was included in German Luftwaffe experimental devices, upon which the German experts set high hopes. The final (and, for total air defence, absolutely necessary) development is an automatically triggering ("blind-aiming") sight, in combination with radar stalking. It is hard to see how, otherwise, night

COMPARATIVE DATA ON AUTOMATIC GUNS

Type	Calibre (mm)	Operation	Weapon Weight (lb)	Weapon Length Overall (in)	Muzzle Velocity (ft/sec)	Rate of Fire (rds/min)	Projectile Weight (oz)	Remarks
Browning (Brit. re-design)	7.7	recoil-operated; mechanically locked breech	22	44.5	2,660	1,200	0.344	Belt-fed.
Vickers K	7.7	gas-operated	19.5	—	2,400	950-1,200	0.344	Drum-fed.
Gorman MG.81	7.92	ditto.	14	—	2,450	1,200-1,500	0.45	
Rheinmetall-Borsig MG.17	7·92	recoil operated; mechanically locked breech	28	47.2	2,450	1,100	0.45	Belt-fed.
U.S. Browning	12.7	ditto	52	58	2,500	850	1.7	Belt-fed.
Oerlikon F.F.	20	ditto (with free blow-back)	53	52.8	1,930	520	4.82	"Mine" shell with 0.69 oz H.E. charge.
Hispano Mk. V	20	ditto	105	81	2,750	600	4.25	Splinter shell. No remote cocking.
Mauser MG.151/20	20	ditto	98	80	2,600	680	5.35	Made in 95 working hours (mass production); also produced with 15 mm calibre (muzzle velocity 3,150 ft/sec).
Mauser MG.213/20	20	gas-operated	165	—	3,300	1,200	7.4	Extra-long "mine" shell with 0.9 oz H.E. charge.
Rheinmetall-Borsig M.K. 108	30	recoil-operated with free blow-back	132	4h5	1,650	650	11.6	"Mine" shell with 3 oz H.E. charge. Made in 75 working hours.
Mauser MG.213/C	30	gas-operated.	166	63	1,750	1,100	11.6	To replace M.K. 108.
Vickers-Colt type 1932 ...	37	recoil-operated with mechanically locked breech	200	77	1,950	100	23.5	As installed in Perth flying boats.
M.K.214/A	50	automatically actuated charging cradle.	1,060	163	2,750	145	53.5	Adapted tank gun. "Mine" shell with 12.3 oz H.E. charge.
M.K.112	55	gas-operated	600	79	2,000	300	52.4	For 1,000 yd combat range. "Mine" shell with 14.8 oz H.E. charge.
M.K.412	55	ditto	398	—	2,140	—	52.4	Parallel development to M.K.112.
M.K.114	55	ditto.	1,550	—	3,300	180	63.5	For 2,000 yd combat range, with semi-rigid mounting. "Mine" shell with 16 oz H.E. charge.
M.K.214/B	55	ditto	1,430	—	—	180	63.5	Parallel development to M.K.114.
M.K.115	55	recoilless (venturi-relief)	395	—	2,000	300	54.4	Combustible cartridge case. Development not completed.

FIGHTER ARMAMENT . . .

or cloud interception could be anywhere near effectual. Such a device, too, will bring some welcome relief from the growing ammunition loads which the intercepter aircraft is compelled to carry. Designs for instruments of this kind exist, but the writer is doubtful whether they are approaching operational use by any of the Western Powers.

According to German assessment, 50 per cent probability of destruction could be expected from a two 30 mm M.K.108 gun installation firing over 700 yards' range at flight-path angles up to 30 deg, *provided* that the EZ/42 gyro-sight was used. The assumption is an aggregated rate of fire of 600 rounds/min lasting three seconds, and a muzzle velocity of 1,870 ft/sec, i.e., the expenditure of 20 shells, with four direct hits effecting the destruction. Without gyro-sight, equal probability can be predicted when fire is opened over 450 yards only. Hence, an automatic sight is an excellent protection for the intercepter, besides giving better chances of success.

Weight and Bulk.—In piston-engined intercepters a low armament-installation weight is of primary importance, but the space required does not matter a great deal. Jet and rocket intercepters, however, present "logistic" armament problems: they are more susceptible to bulk than to weight. Humps, blisters, or protruding barrels are no longer tolerated. Then there are the problems of facilitating armament servicing and re-arming, both of which are operationally vital: the higher the target's speed and altitude, the smaller the time interval available between alert and interception. Standing intercepter patrols may no longer be considered a tactical error of the First World War. Servicing and re-arming, therefore, dominate the practical usefulness of an intercepter aircraft.

As has been said, the large-calibre gun is necessarily long and needs much ammunition space. In jet-fighter design the fuselage nose is easily occupied by four guns of, say, 55 mm calibre; the cockpit may even have to be shifted back (decreasing the field of vision), and no space may be left for radar equipment. Moreover, the recoil loads may have a disturbing effect upon automatic detection, ranging and firing devices. Even 20 mm guns can produce vibrations causing distressing consequences for airframe and accessories. Moreover, the fuselage nose is better employed to house the pilot, especially if he is to be in the prone attitude. Finally, the best place for a refuelling "probe" is undoubtedly at the fuselage nose.

Wing installation of guns no longer seems a practical proposition: modern jet intercepters have thin wings, and these are sensitive against shock loads from recoil. Wing roots, too, are generally occupied by air intakes and/or discharge ducts. Also an eccentric installation of heavier-calibre guns presents potential danger if one of the weapons jams.

One may safely predict that in future intercepters the fuselage nose will no longer be available to house a gun installation, apart from the fact that the structural system will be unfavourable to it. These reasons make it desirable to replace guns by some other form of armament, and one with which the aircraft designer can do better. Rockets produce no recoil, and, if they are small enough, they can be stored anywhere and be launched from any place.

Although economical aspects claim only minor attention in a struggle for the survival of a nation, intercepter armament claims consideration in this respect. Costs of equipment and, in particular, armament, form rather formidable items, yet the actual operation life of such an aircraft is amazingly short. During the last war, the average flying life was 40 to 50 flying hours (more than double the average life of a fighter during the First World War); an increase to, say, 400 flying hours is hoped for with very modern types—of vastly higher initial cost. A simplified armament, consisting in effect of little more than the missiles to be fired, will thus be beneficial from the point of reducing labour, saving material and lowering final cost. In maintenance, too, rocket missiles of the R.4/M type will score.

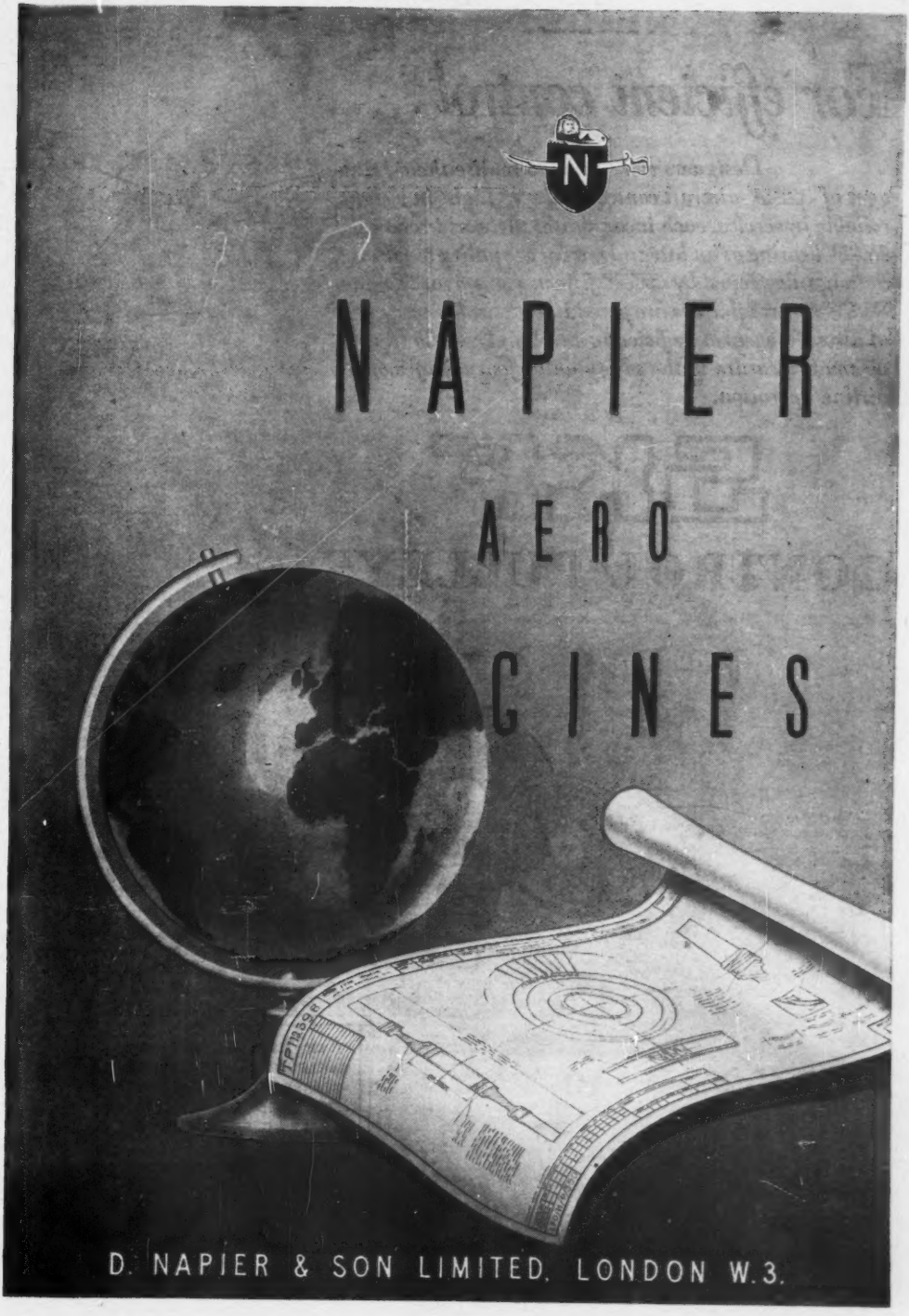
Estimating formulæ have been worked out, on the basis of experimental data, to assess quantitatively the calibre influence upon weapon property and performance; and similar formulæ established for supersonic rocket missiles allow us to compare automatic shell-guns with such missiles. Quantitatively, the investigation leads to the conclusion that the advantages of rockets, in all respects, are too great to be overlooked.

(To be concluded)

LOWERING PRODUCTION COSTS

AT the annual general meeting of Joseph Lucas, Ltd., Sir Peter Bennett, O.B.E., J.P., M.P. explained how the company was endeavouring to reduce selling costs by a continuous programme of reducing all manufacturing costs that came under its control.

The manufacturing time set for any product was treated as its index of controllable cost and compared with the time set by American manufacturers for a corresponding product. When the volume of production was similar, as in the case of aircraft equipment, the variation between the British and U.S. times was negligible; in car equipment, the American production of which was very much greater, the comparison showed an appreciable (though narrowing) gap.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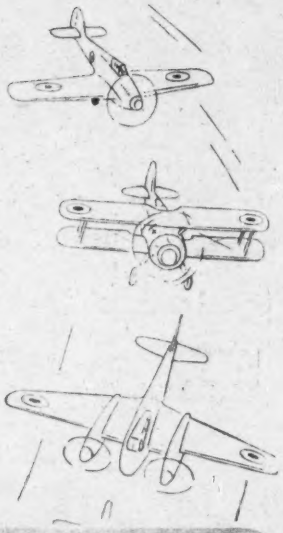
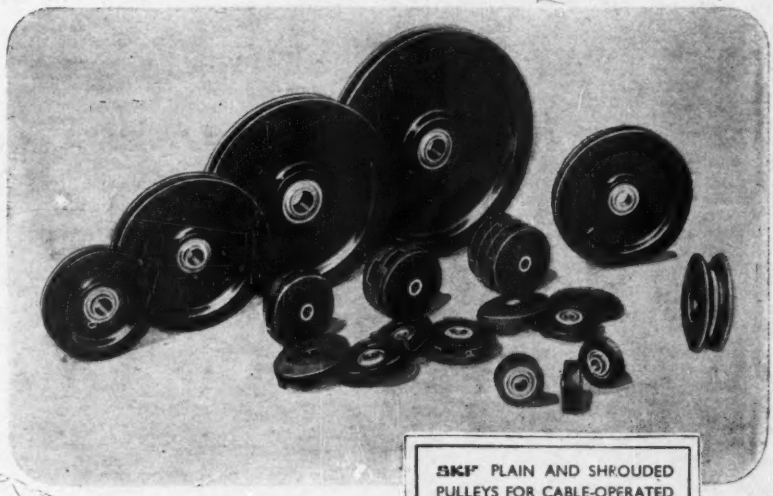


SKF

CONTROL PULLEYS



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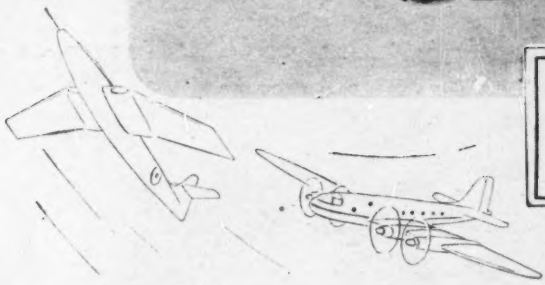

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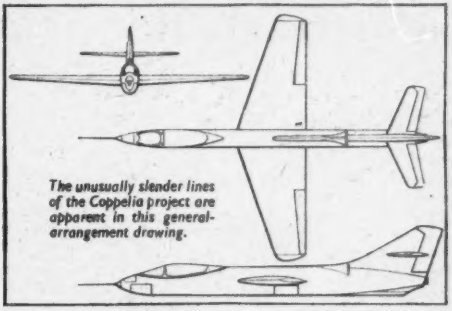
FROM ALL QUARTERS

ADDER-POWERED RACER

PRIMARILY intended for the 1953 England-New Zealand Race, and conforming to the F.A.I. Light Aircraft 5th Category (weight 3,000-4,500 kg), the Coppelia racing aircraft, illustrated here in its preliminary form, has been designed by a Londoner, Mr. George Korab, B.Sc., A.F.R.Ae.S. Originally, the installation of two Turbomeca Piméné turbojets was foreseen, but their combined static thrust of 440 lb proved inadequate, and redesign was undertaken round a single Armstrong Siddeley Adder (1,100 lb static thrust).

Pilot and navigator are seated in tandem, and provision is made for two JATO units under the jet-pipe at the rear of the metal-constructed fuselage. Fuel tanks occupy all the centre



The unusually slender lines of the Coppelia project are apparent in this general-arrangement drawing.

portion of the fuselage and project into the wing, which is of mixed construction.

Span and length are, respectively, 32ft 9in and 44ft 4in, and a maximum sea-level speed of 406 m.p.h. is estimated. The range should be 2,900 miles and the take-off distance to 50ft, with full load and without JATO, 1,550 yd.

FOR BRIGHTER AIRCRAFT

TO the Jenolite range of A.R.B.-approved preparations (which include R.R.N.1 rust remover and A.K.S. aluminium keying solution) has now been added a new aluminium- and magnesium-alloy degreaser and cleaner, to be known as Jenolite A.C.

Stated to be incapable of attacking the metal itself, however highly it may be polished, the new cleaner is supplied in powder form and is used in water in the proportion of 1 lb/gallon. It can be applied cold by brushing, or parts can be immersed in a bath warmed to a temperature of up to 50 deg C. The solution is claimed to have high wetting characteristics and to be non-caustic and non-injurious to rubber.

The makers, Jenolite, Ltd., have headquarters at 43, Piazza Chambers, Covent Garden, London, W.C.2; samples of the new preparation may be obtained on application to their branch at 5, New Bridge Street, London, E.C.4.

STRATOJET FLUTTER TESTS

THE Boeing Stratojet medium bomber is believed to be subject to greater skin-stress than is any other aircraft of its size; it is very important, therefore, that vibration and flutter be kept to a minimum. With this end in view, the makers conducted a number of wind-tunnel tests with a specially constructed model.

The tests were unusual in that the model actually "flew," supported by the tunnel's airstream and a wire tether to prevent it from being blown down the throat. Outwardly, the test-piece was identical with the actual Stratojet; the scale was 0.075—a twelfth.

Other scales, with one exception, were all different. The weight scale was 0.075 cubed, or 0.000421875; at 13,000ft this was equal to a weight scale of 0.0006117—or about one two-thousandth of the Stratojet's real weight. The stiffness scale was a little more than one millionth of that of the full-sized aircraft. The vibration-frequency scale, however, was of a comparatively large order—2.33—which meant that if something on the model vibrated ten times a second, the same part on the actual Stratojet would vibrate at 23.3 times a second. The speed scale was set at 0.1745, equivalent to 515 m.p.h. in a 90 m.p.h. wind-tunnel airstream. The instrumentation of the flutter model, and high-speed cameras to record its behaviour, completed the equipment required for the tests.

A 29-core electric cable led to the model from the wind-tunnel roof; the cable was so arranged that it could easily rise or fall with the test-piece. The conductors were connected to motors which operated control surfaces; accelerometers which recorded the frequency and amplitude of vibrations; and strain gauges which instantly detected the mechanical stresses at suitable points on the model.

"NO HIGHWAY" FILMED

THROUGHOUT the aviation world, the reading of Nevil Shute's *No Highway* became a "must" very soon after the book appeared: such was (and is) the value placed upon a first-class story produced by a man who knows his subject. That it would make a fine film undoubtedly occurred to hundreds of readers of the book; and now a film has, in fact, been made. Marlene Dietrich, James Stewart, Glynis Johns and Jack Hawkins star in this Twentieth Century-Fox production, which was made at Denham, and a good deal of which was shot actually within the security-sacrosanct precincts of the R.A.E. Inevitably, perhaps, the script departs from the book, but to what extent one will be unable to judge until the picture is shown.

Whilst the film was being made we were able to visit the studios to see how things were progressing, and we also visited Blackbushe one freezing night when the specially built aircraft was crashed.

Perhaps we are too pernickety, too hag-ridden by the demands of accuracy, to shrug off various technical absurdities which seemed to be finding their way into the film. We must agree that the proportion of the cinemagoers who will see *No Highway* and who will be aware of the aeronautical ineptitudes is likely to be small; but we cannot reconcile this argument as justifying them.

To some extent, one can sympathize with the film-makers concerned, for they had above all to ensure that the aircraft portrayed should not be identifiable with any existing type. They have certainly succeeded, for they have designed a prototype which, although the majority of filmgoers may accept it in blissful ignorance, will not, we think, fail to elicit the most ribald reactions from those of us who are concerned with aircraft as they are in practice. One of the most surprising aspects of the situation is that technical advice was given to the studio from

Art director C. P. Norman chats with the technical editor of "Flight"—who looks unconvinced—on the set at Denham during the filming of "No Highway."

what we should have thought a reliable source. However, the giving of advice does not necessarily imply that that advice will be taken.

Despite these gloomy comments, we would enjoin everyone who can to see this film. The cast is good—although this is, perhaps, a little more than can be said for the casting—and the direction (by Henry Koster) is likely to be more than competent. In saying this, our judgment is based on having seen some of his previous films and also on seeing Mr. Koster at work during our recent visits.

C. B. B-W.

Left to right: Marshal of the Royal Air Force Lord Trenchard (O.M.), Air Chief Marshal Sir James Robb (G.C.B.), Air Marshal C. R. Steele (K.C.B.), A.Cdre. C. E. Chilton (C.B.), A. J. Pegg (O.B.E.), H. Constant (C.B.E.).

THE NEW YEAR HONOURS

O.M. for Lord Trenchard : Knighthood for Short and Harland Chief

EVERYONE who is aware of the part which Marshal of the Royal Air Force Lord Trenchard played over a long period of years in fostering the magnificent tradition of the Service will have learned with satisfaction that the Order of Merit is to be conferred upon him by the King. The honour is a signal one, for this very distinguished Order is limited to twenty-four members.

Other senior officers whose names appear in the New Year Honours List published last Monday include Air Chief Marshal Sir James Robb, the C.-in-C. of the Western Union Air Forces, and Air Marshal C. R. Steele, A.O.C. in C., Coastal Command.

This year the aircraft industry is not very strongly represented in the lists, though a knighthood is conferred upon Mr. E. D. A. Herbert, chairman of Short Bros. and Harland, Ltd.

Among those created Commanders of the Order of the British Empire, in the civil lists, are Mr. Hayne Constant, Director of the National Gas Turbine Establishment and Mr. A. H. R. Goldie, Deputy Director (Research), Meteorological Office. Similarly honoured are Mr. E. Sanders, managing director of Helliwells, Ltd., and Mr. S. Kenneth Davies, prominent in civil aviation affairs.

The flying side is represented by "Bill" Pegg (O.B.E.) who, as chief test pilot of the Bristol Aeroplane Company, has been responsible for flight-testing the Brabazon.

Among the names published are the following (R.A.F. awards, i.e., A.F.C.s, etc.), will be given next week:—

KNIGHT

E. D. A. Herbert, chairman, Short Brothers and Harland, Ltd.

ORDER OF MERIT

Marshal of the Royal Air Force Lord Trenchard.

ORDER OF THE BATH

Companion (Civil)

Cdr. S. S. C. Mitchell, chief engineer, Armaments Design Establishment, M.O.S.

Knight Grand Cross (Military)

Air Chief Marshal Sir James Milne Robb.

Knight Commander (Military)

Air Marshal Charles Ronald Steele.

Companions (Military)

Air Vice-Marshals: W. A. D. Brook; D. Macfadyen. Actg. A. V-M. T. N. McEvoy. Air Commodores: C. E. Chilton; W. L. Freebody; S. Wallingford, R.N.Z.A.F.

ORDER OF THE BRITISH EMPIRE

Knight Commander (Civil)

H. M. Garner, Chief Scientist, M.O.S.

Commanders (Civil)

H. Constant, Director, National Gas Turbine Establishment, M.O.S.; A. H. R. Goldie, Dep. Dir. (Res.) Met. Off., Air Ministry; E. C. Kitts, Asst. Sec., Air Ministry; E. Sanders, mg. dir., Helliwells, Ltd.; J. E. Serby, Dep. Dir., Royal Aircraft Establishment; S. Kenneth Davies, chairman, Welsh Advisory Council for Civil Aviation.

Officers (Civil)

A. W. Angus, Dir. of Inst. Prod., M.O.S.; R. C. Bloodworth, Dep. Dir. (Finance), M.C.A.; A. G. Bonny, chief engineer, Tech. Training Command; E. A. Lovell, Prin. Scientific Officer, Air Ministry; A. J. Pegg, chief test pilot, Bristol Aeroplane Co., Ltd.; C. G. White, principal, Air Ministry; A. R. S. Vickers, "Flying Doctor" Service, Australia; C. J. A. Whitehouse, principal, M.O.S.

Members (Civil)

F. P. Alexander, sen. ex. off., M.O.S.; P. R. Allison, sen. exp. engr., Flight Refuelling, Ltd.; G. Briggs, exp. mgr., Airspeed, Ltd.; J. J. Brown, chmn. of cmmtee., No. 1465 Squadron, A.T.C.; S. T. Cope, prin. moorings off., Air Ministry; T. S. Duncan, asst. designer, Vickers Armstrongs, Ltd. (Weybridge) Aircraft Division; G. H. Fillmore, Civil Asst. and Acc., No. 27 M.U., Air Ministry; T. F. Fry, officer-in-charge, Jersey Town Office, B.E.A.C.; E. D. Gilding, signals off., M.C.A.; G. J. Gordon, lately higher ex. off., M.O.S.; W. R. Harrison, sen. ex. off., M.O.S.; E. Hirst, higher ex. off., M.C.A.; O. C. B. Hughes, higher ex. off., Air Ministry; C. A. James, ch. ex. off., M.O.S.; W. J. J. Keen, higher ex. off., Ministry of Defence; C. J. Pattiston, ch. engr., Hobourn Aero Components; L. Rushforth, head of section, research lab., British Thomson-Houston, Ltd.; D. E. Speigal, base eng. supt., B.O.A.C.; R. H. Stone, lately higher clerical off., M.O.S.; Miss D. Stuffield, supt. of typists, Air Ministry; R. W. Ward, expl. designer, Gloster Aircraft Co., Ltd.

Commanders (Military)

A. V-M. J. E. Hewitt, R.A.A.F.; Act. A. Cdre. R. G. Bowditch.

Dame Commander (Military)

Air Commdt. Helen Wilson Cargill, P.M.R.A.F.N.S.

Knight Commander (Military)

Actg. Air Marshal T. A. Warne-Browne.

Commanders (Military)

A. V-M. P. E. Maitland (retd.); Air Commodores: V. S. Ewing; P. Jones; W. A. Opie; L. Taylor; Group Captains: G. C. Bladon; E. J. Corbally; E. J. Laine; K. J. McIntyre; H. W. Penney.

Officers (Military)

Temp. G/C. C. T. Hannah, R.A.A.F.; Wing Commanders: R. Alcock; L. T. G. Barber; C. T. Jackaman; R. J. B. Jackson; F. M. Milligan, A.M.S. Manhire, R.N.Z.A.F.; F. W. J. Paddon; A. Pyke; A. E. Sims; Actg. Wing Commanders: B. R. W. Hallows; H. L. Roxburgh; C. V. Winn; Squadron Leaders: J. M. Birkin; G. Blair; O. Gradon; A. H. Humphrey; G. B. Walford; Actg. Squadron Leaders: A. R. Driessen, R.A.F.V.R.; J. E. Loxton; M. C. Hart; Miss A. J. Wheatley, Prin. Matron, R.A.A.F.N.S.

Members (Military)

Actg. W/C. C. A. P. Noseworthy, R.A.F.V.R.; the Rev. A. E. Cook; S/L. A. G. R. Green; J. W. Nankiven, R.A.A.F.; Actg. S/L. J. C. C. Taylor, R.A.F.V.R.; Flight Lieutenants. L. J. B. Blood; A. G. Bullen; A. J. Dicker; H. Fishwick; W. J. Holmes; R. J. Kennet; A. Machin, R.A.A.F.; C. Mayhew; J. Meech; C. Merrick; W. L. Nix, R.Aux.A.F.; D. L. Overton; I. A. Parry; R. C. D. Vincent; S. A. Warren (retd.); C. B. L. Warwick; V. E. M. Watkins; Temp. S/L. F. Stiller, R.A.A.F.; Actg. Flight Lieutenants: F. D. Mainland, R.Aux.A.F.; A. J. Spence; Rab Khamsi Eshu Hamzo, Iraq Levies; F/O. F. H. R. Lambourne; Warrant Officers: H. Clapp; F. C. Hamilton; O. N. E. Johannesen, R.A.A.F.; A. T. Knell; A. P. H. Lee, R.N.Z.A.F.; J. Pollock; R. J. Smith; W. S. Smith, R.N.Z.A.F.; A. M. S. Stevens; Actg. W/O. G. W. Rutter.

BRITISH EMPIRE MEDAL (Civil)

A. C. Blay, sect. insp., N.4 line, B.O.A.C.; Mrs. M. L. Coles, manageress, Y.M.C.A., canteen, R.A.F. Station, Yatesbury; J. Cosh, charge-hand, Radar Research and Development Establishment, M.O.S.; A. Gardner, chief off., works fire brigade, Armstrong-Siddeley Motors, Ltd., Coventry; F. R. Girdlestone, chghd. fitter, No. 4 maintenance unit, R.A.F., Ruislip; J. T. Hathaway, rolling mill foreman, Henry Wiggin and Co., Ltd.; J. King, construction fitter, Shell-Mex and B.P., Ltd.; E. G. Long, foreman, Aeronautical and General Instruments, Ltd. (Morden, Surrey); A. D. Morgan, supt. of stores, No. 61 maintenance unit, R.A.F., Handforth, Abingdon; Mohammed Yakub, station engineer, R.A.F., Habbaniya, Iraq.

BRITISH EMPIRE MEDAL (Military)

Actg. W/O. E. Hardisty; Flight Sergeants: E. W. Browning; G. E. Davis; W. Foster; J. E. Lowe; R. A. Masters; F. G. Miller; W. J. Rousseau; W. H. Steer; R. Stephens; W. Tomlinson; H. J. Henderson, R.Aux.A.F.; B. Robinson; A. F. See, R.A.A.F.; L. A. Wright; Sergeants: C. H. H. Allen; R. G. Carey; L. Dring; H. T. Hathaway; H. P. Howell; T. E. King; A. H. Landry; R. M. Peto; K. W. Russell; F. Cousins; Act. Sgt. T. S. Henderson, R.A.A.F.; Corporals: J. R. Clay; T. E. Dean; G. W. Marshall; J. A. Stannard; D. W. Mitchell; L/A.C.W. Maisie E. Dabinett, W.R.A.F.

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By JOHN YOXALL PART II

No. 6 SQUADRON R.A.F.

1939-1950 : Anti-tank and Anti-shipping Work in the Second World War

(Part I of this article, published last week, told the story of the squadron from its formation in 1914 and through the inter-war years)

AT the outbreak of war in 1939 the squadron was at Ramleh and Haifa. A mixed collection of aircraft was on charge. At Ramleh there were ten Hawker Hardys, six Gloster Gauntlets and two Westland Lysanders, and at Haifa another eight Hardys. Although the unit had been on a war footing for a long while, a complete mobilization order came into effect on September 3rd. Life went on much as it did before, with operations against Arab bands, but by the end of January, 1940, it was felt that the lack of operational commitments would allow for a return to a more normal training programme.

The importance of this programme was accentuated a month later, when the role of the squadron was changed back to one of army co-operation. S/L. W. N. McKechie, E.G.M.,* was in command at the time and the unit was still at Ramleh. On charge were 13 Lysanders, two Gauntlets and one Hardy. The remaining Hardys had been allocated to the Rhodesian Air Force for training.

It is curious that during a major war the squadron should have had one of its longest periods of non-operational flying: but from January to September, 1940, only training flights were made, interrupted by a stand-by when the Italians declared war in June and by a demonstration to show newcomers how to handle some undesirable elements of the Palestine rebellion who had drifted back.

In September, C Flight left Ramleh for Qasaba, Egypt, for operational training and the first sortie by No. 6 against the Italians was by F/L. McFall, D.F.C., who made a tactical reconnaissance over the Bogora-Matruh area.

S/L. R. E. Weld took over command, and a full list of squadron duties included tactical reconnaissance with the Australian Division, the organization of No. 4 Air Intelligence Liaison Officers' Course, desert reconnaissances, coastal patrols to spot refugee-ships and submarines, and occasional trips to Amman to co-operate with the Arab Legion.

* *E.G.M.—Empire Gallantry Medal*

On October 1st, F/O. Haythet, flying from Qasaba, detected enemy activity at Maddelena and an attack was made. The next day, F/L. Hay, operating from Siwa, saw so much enemy transport on the move that it was certain that the Italians were building up. To discourage No. 6's work the Italians sent five Savoia S.79s over Qasaba, where they dropped between 30 and 40 100 kg H.E. bombs without causing either damage or casualties.

A month later, when B Flight relieved C Flight, the squadron sustained its first casualty of the 1939-45 war. F/L. D. T. St. H. Dawes and his air gunner, Sgt. Chantry, were shot down by flak. They were buried beside their wrecked Lysander.

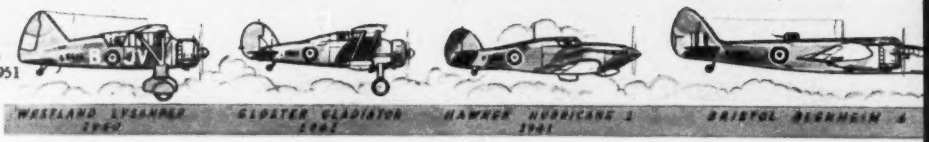
Meanwhile, from Ramleh, S/L. Weld led a formation of six Lysanders to salute the Emir Abdullah of Transjordan on the occasion of his receiving the honorary rank of Air Commodore in the R.A.F. After the fly-past the pilots were presented to the Emir, who showed great interest in the squadron that had been his air bodyguard for nearly 20 years. Early in 1941 the C.O. and some of the officers were entertained by the Emir and his son at their winter camp in the Jordan valley.

The disposition of the squadron at the beginning of February, 1941, was: H.Q. and C Flight at Ramleh; A and B Flights at Tobruk, attached to H.Q. No. 202 Group. Events moved fast, however, and a month later road and rail parties left for Heliopolis to take over from No. 208 Squadron at Barce, Cyrenaica. A Flight was re-equipped with Hurricane Mk 1s and based at Agedabia to operate with the 2nd Armoured Division. B Flight stayed at Barce with squadron H.Q. to fly flank recces and perform general army co-operation duties.

C Flight remained at Heliopolis to be re-equipped with long-range Lysanders for co-operation with certain of our forces which were to attempt the capture of one or more of the Dodecanese islands. This project was dropped within a fortnight.

At the beginning of April, when the German advance materialized, A Flight stayed with the forward troops until their landing ground was menaced. The squadron was ordered to retire on Maraua, where A Flight rejoined the unit. In

(Left) "A" Flight with their Lysanders at the A.O.C.'s inspection in 1940. (Right) Emir Abdullah of Transjordan passes down the line of aircraft as he inspects the squadron on the occasion of his appointment as an Honorary Air Commodore of the Royal Air Force.



No. 6 SQUADRON R.A.F. . . .

the confusion of the retreat, S/L. Weld and the ground party were lost for two days, but eventually turned up intact.

The enemy again outflanked our troops and a further withdrawal was made to Derna, but for a short while A Flight went back and operated from Maraua. F/O. Pike, in charge of the road party, found that enemy armoured units threatened to cut off Derna; on receiving this information he moved on to El Adem.

A message was dropped on A Flight explaining the position. They, also, attempted to withdraw. The air party flew to Gazala and continued to carry out Tac. R sorties, arriving at El Gubbi, within the perimeter of Tobruk, on April 8th. F/L. Saunders and a percentage of the ground personnel were cut off and taken prisoner.

Ordered to stay in Tobruk for so long as the garrison held out, the squadron moved over to the west airfield. General Wavell, visiting Tobruk, personally thanked No. 6 for its work during the withdrawal; and later, on his return to H.Q. in Cairo, he sent along a couple of bottles of champagne as a token of his esteem.

The unit's aircraft suffered badly from lack of spares, but not once was a request for a recce refused. Lysanders were often flown without tail wheels and Hurricanes with non-operative hydraulics. On one sortie from Tobruk F/L. McFall, D.F.C., and his air gunner, Cpl. Copley, shot down a Ju52 over Mechili.

B Flight pilots, who normally flew Lysanders, were introduced to the controls of the Hurricanes. Each did some "circuits and bumps" before taking the fighters on ops, but air space was so limited at Tobruk that during each of these practice flights the Hurricanes were fired on by enemy flak. There were no casualties from this cause.

On April 19th, A and C Flights were ordered to report to 204 Group H.Q. at Maaten Bagush. Four long-range Lysanders took off at night to avoid enemy fighters and two more pilots departed in the squadron Magister. Maaten Bagush was reached safely; the only hazards encountered were the British searchlights and anti-aircraft guns in Tobruk, which opened up as they flew over.

One of the 40-mm-gun Hawker Hurricane 2Ds at Shandur in 1942.

Not a wing-loading test, but a squadron group photographed at Fayid, in the Suez Canal zone, in 1943.

The Hurricanes left Tobruk, under the command of F/O. H. G. Fletcher, flew many reconnaissances and conducted successful artillery shoots under appalling conditions. Regular and intense shelling of the airfield was one major trouble, enemy fighters another. The Germans were based at Salala, only 20 miles away, and when their ground troops reported Hurricanes taking off, the Messerschmitt 110s would arrive over Tobruk and wait for the Hurricanes as they came in to land.

S/L. Weld was killed on a reconnaissance during April, and with his going the unit lost a very fine commanding officer. He had set a splendid example of courage in adversity and had undoubtedly saved many of his squadron from falling in enemy hands during the withdrawal. S/L. P. Legge took over; he was no stranger to the squadron, for he had been with No. 208 when No. 6 was attached to them for a while during the previous year.

During the middle of May, 1941, came news of the intended army attack to relieve Tobruk and everyone concerned was asked to make a very special effort. No. 6 excelled itself and a number of congratulatory messages were received. While on a Lysander recce on the evening of the 16th, F/L. McFall located the advanced units of the enemy, which had broken through the wire and were attacking our troops in force. He landed beside a battery of guns and directed their fire. Two days later he put down by our forward troops, discussed the situation with the brigade major, and then took him up and showed him the enemy dispositions. For this he was awarded an immediate Bar to his D.F.C.

At the end of May the last Lysander recce was made—by F/O. Hillier—around Maddelena. From then onward Hurricanes were used.

The actual attack opened on June 15th at 0600 hrs. F/O. Hardiman was first off and reported that the battle was going satisfactorily. P/O. McBarnett was next away. He was in company with a cannon Hurricane of No. 274 Squadron when three Me109s attacked. Both Hurricanes were shot down; the 274 Squadron pilot was killed and McBarnett, wounded, walked back to our lines.

F/L. McFall was next away; intercepted over Fort Capuzzo he had to crash land at Sidi Barrani. Enemy aircraft ground-strafed him in the wreckage of his aircraft and he was so badly wounded that he died the next day. Two more pilots, P/Os. Sowrey and Grosvenor, were lost on the 24th and 25th.

After such a gruelling time the squadron was more than overdue for a short breather and, being relieved by No. 451, R.A.A.F., moved up to Tel Aviv rest camp for six weeks.

At the end of the rest period a move was made to Wadi Halfa with C Flight at Kufra Oasis. The Hurricanes had gone and the squadron again had a mixture of aircraft on charge—three Lysander Mk. 1, three Lysander Mk. 2, five Gladiator Mk. 1 and six Gladiator Mk. 2. In September two Hurricanes were added to this miscellany and in November three Blenheim 4s, complete with crews, were allocated for service at Kufra.

On the last day of 1941 came news of a move to Iraq. Gladiators were flown to Khartoum and the detached flight returned to the unit, which foregathered at Helwan until it moved to Kilo 26 on January 22nd. S/L Legge was posted to H.Q. Middle East and S/L Roger Porteous came from Iraq Command to take over.- This period marked the all-time low in equipment—the squadron's aircraft on charge was just one Hurricane Mk.1.

Scarcely had the unit settled-in than there was talk of a move to the Sudan—in fact, some of the airmen were detached on duty to Port Sudan. It transpired, however, that the squadron was to be re-equipped and again sent into action. To this end they were sent to Landing Ground 224, on the Alexandria-Cairo road, and until their new mounts were ready helped to receive and service aircraft and crews operating from Malta at night.

On April 20th, 1942, the squadron moved to Shandur and started intensive training on Hurricane 2Ds each fitted with two 40mm "S" guns for tank busting. Eighteen rounds were

carried for each gun and the recoil during firing cut flying speed down by some 40 m.p.h. Two .303 guns were also carried for sighting purposes

After only five weeks' training with the new weapon, No. 6 was sent to Gambut for operations in the Western Desert. In common with all other squadrons, No. 6 was required continually to be at two hours' readiness to move—either forward or rearward, according to the fortunes of the day.

The debut of the 2Ds came on June 7th, but the sortie was abortive in that the target was found to be unsuited to the new form of attack. On the next operation the destruction of two tanks and two lorries was claimed. From then onwards there was a continuous list of tanks and motor transport of all sorts damaged or destroyed, though not always without casualties on our side.

The unit was still moving, first to L.G. 75, later to Sidi Haneish. These moves were followed almost immediately by two more, to L.G. 106 and L.G. 91. Pressure was so great that, in order to get every possible aircraft serviceable, the squadron was told to ignore major inspections. Enemy bombing also caused a lot of extra work. Nevertheless, most effective fighting was being done and the list of enemy vehicles claimed mounted quickly.

In the last week of July, 1942, Air Chief Marshal Sir Arthur Tedder arrived by air in a captured Fieseler Storch to visit No. 6 and inspect the gun-carrying Hurricanes.

Early in August two immediate D.F.C.s were awarded. F/L Hillier gained his by pressing home a determined low-level attack on armoured vehicles in the Sidi Rezegh area. He was so low that he broke off his tailwheel and part of the tail unit on one of the tanks he attacked. F/L. Simpson, who received the other award, was wounded in the chest while leading an attack on tanks at Bir Hacheim. Despite this severe wound he continued his attack, scoring further hits, until his Hurricane was hit by flak. With hot oil and glycol smothering his face, he flew blind for a while before baling out at 500ft.

The air liaison officer with No. 6 at this time was Major Hugh Rice, who is now with the public relations department of de Havillands. He recalls for us some interesting happenings of eight years ago.

"My connection with No. 6 Squadron," he writes, "was a very modest one and extended roughly from July to November, 1942. Earlier I had met Roger Porteous when he had No. 244 Squadron in the Persian Gulf in 1941, and used to lumber up to Mosul in an ancient Vincent at intervals to see how the Army Co-operation Flight of two Gladiators, which was Iraq's sole close-support force at that time, was getting on.

"Early in 1942 I was stationed at the Army Co-operation O.T.U. at Aqir, and there we passed out a lot of embryo recce pilots who had just completed their Magister training in Rhodesia. Quite a number of them were posted to the Delta area to join Roger Porteous's squadron, which was then doing something very secret and mysterious. Porteous and his A.L.O., encountered at the Gezira Club, would smile enigmatically, but it gradually became known that they were learning how to handle the Hurricane 2D with its tank-bursting 40-mm guns.

"No. 6 were naturally regarded as very experimental to start with and, indeed, shared an airfield with another experimental squadron, No. 7 S.A.A.F., which had Hurricanes with Jefferies sticky bombs, which were supposed to adhere to tanks but which at that time were only moderately successful. Attached to the two squadrons was a certain group captain who devised even more unorthodox weapons. He would fly at night over enemy areas in an ancient all-black Gladiator with a bomb slung transversely, so that, when released, it would (he said) 'roll along the ground into the target.' His activities were surprisingly successful and quite fearlessly conducted night after night, to the amazement of all.

"The Hurricane 2D first saw action in June, 1942. By the time of the Battle of Alamein there was a reasonable amount of experience accumulated and our own measure of air superiority was continually increasing, although it was not complete. The Hurricane 2Ds were few and vulnerable and were therefore never sent out without medium and top cover. As a result the planning of a strike was a relatively complicated job, particularly as the covering squadrons were themselves pretty busy on routine work. Only targets which were certain to be identifiable at low level, which were not in the thick of the heaviest flak and whose existence and location were absolutely certain were attacked. This policy resulted in a very high percentage of successful operations, with great damage to enemy armour and with very low casualty rates. The Army were always delighted; the Air Staff sometimes faltered in their belief in the justification for so much fighter effort against a target which might be no more than four armoured cars.

"As regards the atmosphere of life in the squadron, I suppose it was very like that of any other desert unit. We were based on a cluster of landing grounds at Amirya, west of the Cairo-Alex road. The area received a good deal of intruder attention from Ju88s at night; I remember one pilot in particular who always preferred playing poker in air raids, because, by being the last under the table, he could just have time to look at the other chap's hand. Each morning it was necessary to watch out for clusters of small spikes dropped over the airfield in order to puncture aircraft tyres.

"As the battle moved forward the 2Ds were sent out unescorted—this policy was the result of the reduction in enemy air resistance and the operational difficulty of getting an escort from different airfields, when the whole air force was moving forward daily. By the time the Tunisian show was over casualties had reached a level which I think could be called 'worrying,' and the 2D was clearly past its prime. Meanwhile, R.P. was coming along.

"The short life of the Hurricane 2D should not be allowed to obscure its positive value over a few short months. Its work was perhaps more directly appreciated by the private soldier in the Eighth Army than was that of any other branch of the Desert Air Force. The armoured divisions in particular came to know that their cavalry units could call for a No. 6 Squadron strike against a small but highly obstructive enemy objective and that, if aircraft were able to come at all, they would almost always achieve something effective. No. 6 Squadron's work was, of course, most intimately tied up with the Army, so that we had three A.L.O.s to the one squadron (as compared with the usual scale of two to a whole wing), and a very high standard of inter-Service co-operation was reached."

Our history of No. 6 may now be resumed on the day when A.V.-M. Coningham visited the squadron and told them of the impending offensive—which actually began on the morning of October 23rd. The famous artillery barrage at El Alamein could be heard at L.G. 89, where No. 6 was stationed.

In the first operation of the battle No. 6 got six Honey* tanks, and two hours later claimed a further eight Honeys and two Crusaders* The fighting was most intense but gradually the enemy gave way and on November 2nd the Eighth Army broke through. All units were ordered to be in the highest state of mobility.

Germans and Italians crowded the roads and No. 6 asked

** The enemy were using a number of captured tanks.*

(Below) Four Hurricane 2Ds of No. 6 Squadron in formation over the Western Desert in 1943. (Right) S/L. Weston-Burt (extreme left) briefing the pilots for a sortie in the El Hamma region in 1943.

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for permission to join the other squadrons in strafing them. This request was refused, but the pilots were allowed to hunt in the southern sector. On one of these trips alone the score amounted to 12 lorries, three semi-tracked vehicles and one transporter destroyed. Another sortie got one Mark 4 special, two Mark 13s, one A.M.C., one Honey, two Crusaders and 17 lorries.

Further confirmation of the effectiveness of the squadron's shooting came from the interrogation of a prisoner, who said his company had twelve tanks when they were subjected to a surprise attack by aircraft using armour-piercing shells. Of the twelve, six were knocked out and left burning; the other six, though repeatedly hit, were able to return to their own lines. One tank was hit six times and another had its turret pierced right through.

A move forward was made to L.G. 172 and a small party capable of servicing six aircraft was kept ready to move forward at a moment's notice, but it gradually became obvious that as a tank-busting squadron No. 6 had had its work at least temporarily suspended. A squadron diary of the time uses the words "there supervened a restlessness and apprehension that the squadron would not be called upon to join the battle in the forward areas." A further disappointment came when they were ordered to transfer to A.H.Q. Egypt, re-equip with Hurricane 2Cs, and perform shipping-protection duties. This last straw provoked most of the pilots into asking for postings to squadrons which were busy chasing Rommel and his army.

The squadron, for its new role, moved to Edku and became part of No. 219 Group. Meanwhile, a further submission was made to the appropriate authority that the unit's knowledge and training as an anti-tank unit was being wasted. Convoy patrols were flown over Alexandria harbour and practice interceptions made, using Bostons as the "enemy." But there was no shooting.

At the turn of the year W/C. Porteous left the squadron and was succeeded by S/L. Weston-Burt. Orders came for a move to Sidi Bu Amudon, to which they staged via Mersa Matruh and Buq-Buq, arriving on January 31st, 1943—the squadron's 29th birthday. The air party left two days later, 21 strong, and all arrived safely with the exception of one Hurricane, which stood on its nose in a patch of soft sand at Mersa Matruh.

Three weeks later a welcome order came to return the Hurricane 2Cs to the Delta, re-equip once more with 2Ds and proceed to Castel Benito to resume tank-busting activities. The greatest enthusiasm was immediately apparent and a speedy pack was completed, despite an intense sandstorm at the time.

No stop was made at Castel Benito and contact with the enemy was again made at Sorman. Operations were carried out in support of General le Clerq's Fighting French, and, as a result, the German forces opposing him were virtually annihilated. On one of these operations S/L. Weston-Burt returned with his main spar nearly severed.

Warfare at this time was very fluid: four days later a further move was made to Senem. On this move the breakdown vehicle with the ground party ran over a landmine. No one was badly hurt, but L.A/C. Green suffered the indignity of having his trousers blown off.

Operations in connection with the battle of the Mareth line were "on" immediately, but, while excellent results were obtained, the casualty rate went up to an alarming extent. Four Hurricanes were lost on the first sortie and in later operations sometimes as many as six aircraft would be lost out of ten or twelve involved. At the same time a surprisingly large percentage of the shot-down pilots managed to find their way back to the squadron. Many epic stories could be told of crash landings and near-capture by the Italians or Germans.

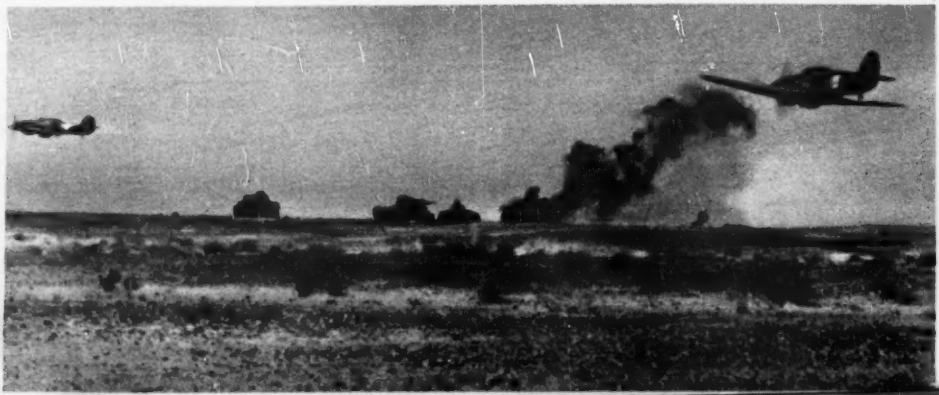
Congratulations were received from Air Marshal Coningham, and General Montgomery sent his "admiration and congratulations for the work today" (March 3rd, 1943). Seven D.F.C.s were gained and S/L. Weston-Burt received an immediate D.S.O. On April 1st the squadron was awarded the King's Standard, for which it had qualified, by its 25 years' service, in 1939.

There followed a dull period. The unit moved on to Gabes and then to Sfax. Sorties were occasionally flown but no suitable targets presented themselves. Cricket and football matches against local units passed the time away, with lectures, classes and impromptu-speech nights to help out.

On May 12th, 1943, all organized resistance by the enemy in North Africa ceased.

Coincidental with the end of the war in North Africa, S/L. Weston-Burt handed over command of No. 6 to S/L. A. E. Morrison-Bell, D.F.C. A move was made to Ben Gardane, where camp was pitched near the lake of Bahirel el Biban. Life was now a little easier. Working hours were 06.00 to 08.00 hr and 09.00 to 12.30.

(Left) Squadron Tempests call at Asmara in Eritrea to refuel in 1947. (Centre) S/L. A. E. Morrison-Bell, D.F.C., who commanded No. 6 in 1943. (Right) S/L. R. Slade-Betts, D.F.C., commander from the end of 1944 to July, 1946. (Below) Post-war practice on tanks at Ramat David in 1945.



At a conference in Cairo the pilots were told of a new weapon to replace the 40 mm "S" gun—rocket projectiles on Hurricane 4s. The first practices with the new weapon were successfully made on September 3rd, 1943.

In this interim period a squadron newspaper was produced. The publication rejoiced in the name of *The Tinopener*, and from it came the unofficial badge which sometimes decorates No. 6 aircraft.

At long last, in the middle of February, 1944, came the news that eight U.S.A.A.F. Dakotas would be made available to take key personnel to Taranto in Italy; the remainder of the squadron would go by ship or in their own Hurricanes. This entailed much weighing and selection before it could be decided exactly what to take by air. The squadron's 21 Hurricane 4s flew via Mersa Matruh, Castel Benito, Malta and Catania to Grottaglie, adjacent to Taranto. This move was completed by February 2nd, 1944, and marked the first occasion on which No. 6 had been in Europe for a quarter of a century.

The first operation of the new campaign, and with the new rocket projectiles, was against an enemy H.Q. near Durazzo. The target was destroyed, but one Hurricane was shot down in flames and W/C. Morrison-Bell's aircraft damaged.

Shortly afterwards came an order that No. 6 would do no more sorties in the land war but would devote all their energies to anti-shipping patrols. A detachment left for Corsica and operations against coastal installations in Jugoslavia—nicknamed Jugland—were also instituted. The first month of anti-shipping work added to the score board five barges, three landing craft, three Siebel ferries, three schooners, one F boat, one 1,500-ton and one 2,000-ton ship and five other vessels. These were all sunk, many others were damaged. Sortie after sortie was flown, often with much success; it was a period during which the unit was obviously at the top of its form.

At the end of May came another change in command W/C. Morrison-Bell, who had joined the squadron in June, 1941, and was one of the original tank busters, handed the reins over to S/L. J. H. Brown, D.F.C. A move was made up to Foggia.

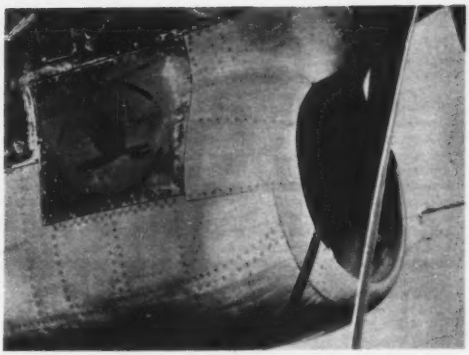
July was another good month—the most successful sortie brought the sinking of the 5,000-ton motor vessel *Italia* in the Arsa Channel. Sixteen R.P. hits were observed. In addition 37 other ships were sunk, including 21 schooners. Unfortunately S/L. Brown was killed. F/Ls. Walker and Davidson each won the immediate award of the D.F.C.

Night reconnaissance was by now part of the normal programme, and on one flight, on August 3rd, F/L. Walker had to bale out. Alighting on the sea, he inflated his dinghy and reached the island of Galjola. After living on his survival rations for five days he was able to attract the attention of a No. 241 Squadron aircraft by firing Very lights. He was eventually picked up by a Catalina which arrived on the scene with a protective escort of 16 Lockheed Lightnings.

By the middle of August squadron headquarters had moved to Canne, Italy, but there were still flights on detachment. Siebel ferries were the targets receiving special attention and it was while attacking one of these that F/L. Black, having used up all his R.P.s, jettisoned his long-range tank into one of them.

The equinoctial gales in the Italian autumn of 1944 brought heavy rain and caused havoc in the tented camp. For several days the orderly room was out of action until some sheet iron and timber was obtained to make temporary shelter.

During November S/L. Langdon-Davis, who had been in command since the death of S/L. Brown, left the unit. He was operationally time-expired with 120 hr 10 min to his credit. To replace him S/L. Slade-Betts came from No. 253 Squadron. At this time, also, there was a visit from General Im K. Eaker, U.S.A.A.F., Commanding General of M.A.A.F. He described No. 6 as the most colourful squadron in his command, spoke highly of their work and—what was much more appreciated by them—promised replacement of the obsolete Hawker Hurricanes by more modern aircraft from the same stable—Typhoons or Tempests.



Not authorized by the College of Heralds : The "Flying Tin-opener" badge stencilled on the radiator cowling of a No. 6 Tempest.

On December 16th a detachment of six aircraft was ordered to Niksic in Jugoslavia. The journey was made by air. Rocket attacks were made on enemy installations in Danilovgrad and Spuz. While operating from Niksic S/L. Slade-Betts was hit by flak and had to bale out over enemy territory. He hurt his right knee on the tailplane as he left the Hurricane and sprained his left ankle on landing—he had to spill his 'chute to increase the rate of descent, for he was being fired on all the time. Despite his injuries he made a successful run for it while partisans put in a diversion to cover his escape.

The Niksic detachment returned before the end of the year and Christmas celebrations followed the usual run of Service festivities, with the officers and N.C.O.s waiting on the airmen. There was, however, one difference: the C.O. and the adjutant gave all the airmen tea (laced with whisky) *in bed*!

Bad weather again held up operations for the first two months of 1945 but in February conditions improved and ten aircraft were detached to Zadar to operate from there The targets were mostly H.Q. buildings in and around Krk. It seems that a sensitive spot had been found, for flak was very intense. A number of machines were hit but casualties were few. An interesting note is that at this time over 75 per cent of the squadron personnel were either time- or tour-expired.

In April came another move. At the end of the first week an L.S.T., with the remainder of the unit on board, left the Adriatic port of Bari for Zadar, where the unit disembarked and went on to the airfield at Prkos. In the confusion of

The squadron in February, 1949. The flight commanders and C.O. in the centre of the front row are F/L. D. O. Luke, S/L. D. Crowley-Milling, D.S.O., D.F.C. and F/L. B. Spragg, D.F.C.

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moving, the squadron dog Rommel was lost, but he was brought over later by No. 73 Squadron.

During the month 338 sorties were flown, amounting in all to 570 flying hours. Three pilots were lost and a further three were shot down but were able to return to the squadron.

The final operation of the war had an element of comical surprise. On May 1st, 1945, four pilots were briefed to contact enemy troopships putting out from Trieste. The operation was led by P/O. A. J. White. A dummy run was made on the leading vessel, which promptly ran up a white flag and then lowered it again. A second pass was made and the white flag went up again and stayed up, the rest of the ships followed suit.

Two Hurricanes stayed with the captured ships and two returned to report. Top cover was maintained over the convoy until it was in our hands. The squadron made a claim of "16 ships captured."

Peace came on May 8th and was suitably celebrated.

For No. 6, however, there was no peace for by the 18th they had changed their four-rocket Hurricanes for the eight-rocket jobs (previously belonging to Nos. 351 and 352, the Jugoslavian squadrons) and were on their way to Canne, Italy, to await trooping to Palestine. Italian military currency was changed for English money and on July 7th the ground party left in S.S. *Carnarvon Castle* for Alexandria. A train journey across the Sinai desert (over the railway which was first laid as a military operation in the 1914-18 war, and was for a while operated by engines from the old London and South Western Railway) brought them to Megiddo (Haifa).

The air party flew via Araxos (Greece), Hassani, Maleme (Crete), El Adem and Mersa Matruh. Only one Hurricane failed to make the journey; it went U/S with a coolant leak.

Then came the whittling down by re-establishment and de-mobilization; but, despite very severe handicaps imposed by post-war troubles, No. 6 never became dispirited or adopted the "couldn't care less" attitude which affected so many units.

Towards the end of August, 1945, there was a further move, to Petah Tiqva. The trophies and plate, of which the squadron is so proud, were drawn from the safe keeping of Barclays Bank in Tel Aviv, polished up and returned to use. Discipline was tightened up a little and a training programme laid down.

Ever nomadic, the squadron next found itself at Ramat David, where pre-war duties such as pipe-line patrols were resumed and added to the training programme. By the end of October the squadron was 40 per cent under strength, mostly owing to de-mobilization; yet even those waiting for their turn to go slaved hard to, in their own words, "keep the kites serviceable."

Owing to the curfews necessitated by the inter-racial disturbances the men were tied more and more to camp. Although they were so near to Bethlehem the first peacetime Christmas was more of a testing time than one of peace and goodwill. Squadron strength was down to less than half and airmen had to be on guard each alternate night because of possible attacks on the camp.

The promised Tempests had not yet arrived, but a few Mk. 9 L.F. Spitfires with "zero-length" R.P. rails and gyro sights adapted for R.P. work were sent to the unit.

S/L. Slade-Betts, D.F.C., left the squadron in July, 1946, for demobilization. He had been a worthy C.O. of a worthy squadron and when he left in a Lancaster for Heliopolis all the serviceable aircraft available at that moment—four Hurricanes and one Spitfire—flew with him as an escort. F/L. Kendell took over temporary command.

S/L. C. E. Mould, who next commanded No. 6, came at a very difficult period. All the aircraft were very old, only four of the pilots were R.P.-trained and three of these were due shortly to leave.

By October, 1946, the Hurricanes were really wearing out—every inspection became a major overhaul. Rock-bottom was reached at the end of November, when pilot strength was down to four, with one serviceable Hurricane. Even so, perusal of the squadron diary shows the old squadron spirit to have been still apparent.

Tempest 6s began to arrive in December, co-incident with another change in command, S/L. C. K. Gray, D.F.C., taking over. For its 33rd birthday party the squadron foregathered at the Palace Hotel, Nicosia, Cyprus, whence a move had been made at the end of the previous September. The birthday cake was cut by the youngest member, A/C. 1 Seaman, and a dinner and sing-song completed the celebrations.

November, 1947, found the unit at Khartoum under the command of S/L. D. Crowley-Milling, D.S.O., D.F.C. and Bar. From here, in the following January, a detachment of six aircraft, 22 airmen and two Dakotas made a journey to Mogadishu, Somaliland. It appears that something went wrong with the logistical department, because when the aircraft came to refuel at Mogadishu there were found to be available 500 gallons of petrol and 5,000 gallons of oil! When this curious disparity had been put right demonstration patrols were flown before the return to Khartoum on February 13th.

In May drop-tanks were fitted and feverish preparations made for a quick move north to cover the evacuation of Palestine by the British Forces.

At least one of the pilots was approached by the Jews to sell his aircraft. The method suggested was that he should land in Palestine, where he would be taken and dumped into the sea. From here he would be "rescued" and removed to hospital before being released. The price offered was £7,000. If anything had happened to go wrong with the rescue apparatus, of course, the aircraft would have been cheaper still!

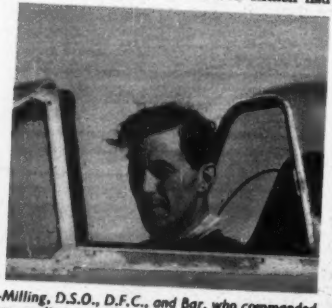
The situation for a while was very tense. As the British columns left, so the Arabs and Jews joined battle. Some air fighting was observed but recognition was difficult owing to the fact that everybody concerned had British aircraft. Owing to attacks by the Egyptian Air Force, all Dakotas flying into Palestine were escorted. One of them carried the late Count Bernadotte, who attempted to mediate between Jews and Arabs.

At the close of the Palestinian troubles No. 6 enjoyed its first spell of real peace since it was formed in 1914.

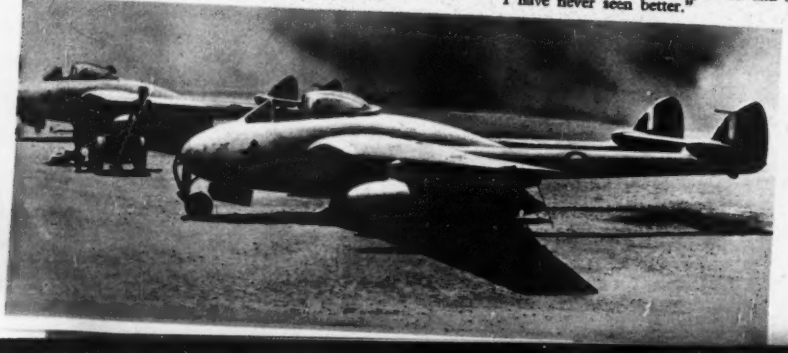
The Tempests have now given place to Vampire 5 fighter bombers and the squadron was in the news when, recently, it went to Mafraq for a four-week desert training exercise. While they were there King Abdullah visited them and was presented with a framed reproduction of the squadron badge in gold and silver brocade, the crown studded with jewels, on a white satin background. In return the King has now presented to the squadron one of his own personal banners. It is of silk, in the Jordan colours, with the royal crown in yellow as a centre-piece.

The presentation took place at the Palace at Amman. A.V-M. G. Beamish, A.O.C. Iraq, attended and Gen. Glubb Pasha, Commander of the Arab Legion, acted as interpreter.

It is appropriate to conclude a history of such a famous squadron with the words of A.V-M. J. N. Boothman, who visited No. 6 in 1950. In a message of appreciation he said, "In No. 6 you have a grand outfit; you may well be justifiably proud of it. The spirit of the squadron and its ability is remarkable. I have never seen better."



(Left) S/L. D. Crowley-Milling, D.S.O., D.F.C., and Bar, who commanded the unit for two years, ending in July, 1950. (Right) The present commanding officer, S/L. P. A. Kennedy, D.S.O., D.F.C.



With the new official badge on their noses: No. 6 Squadron Vampire 5s on desert training at Mafraq in Jordan last August.

Part I. First Principles and a Brief History : Rotating Systems and Their Controls

By Capt. R. N. LIPTROT, C.B.E., B.A.

THE HELICOPTER

Presented here is the first of a sequence of specially commissioned articles from the pen of an internationally recognized authority on rotary-wing aircraft. It is our belief that these contributions will go far towards clarifying many obscurities surrounding the topic, especially as the author displays the rare ability to interpret complexities in simple but precise terms. Captain Liptrot was formerly the Deputy Director responsible for Helicopter Research and Development, Ministry of Supply.

AS this series of articles is intended as an introduction to the subject, and primarily for the not-so-well informed, it is perhaps as well to open with the question "What is a helicopter?" It is one of a family of heavier-than-air craft known as "direct-lift" aircraft, which are characterized by being able to lift themselves vertically off the ground in still air, which can hover motionless over a given spot and descend vertically under their own power, and which, in particular, can make a safe descent into a relatively small space in the event of power-unit failure. In addition, to be of any practical use, they must be able to move horizontally at the will of the pilot at a satisfactory speed, and they must be stable and controllable under all flight conditions.

It will be appreciated that in order to obtain aerodynamic lift we must have suitably shaped surfaces moving at an appropriate speed relative to the surrounding air. In the conventional fixed-wing aircraft the whole vehicle must move at the necessary speed; in direct-lift aircraft, however, the supporting aerodynamic surfaces have this relative velocity quite independently of the motion of the aircraft as a whole, and we have three main classes:—

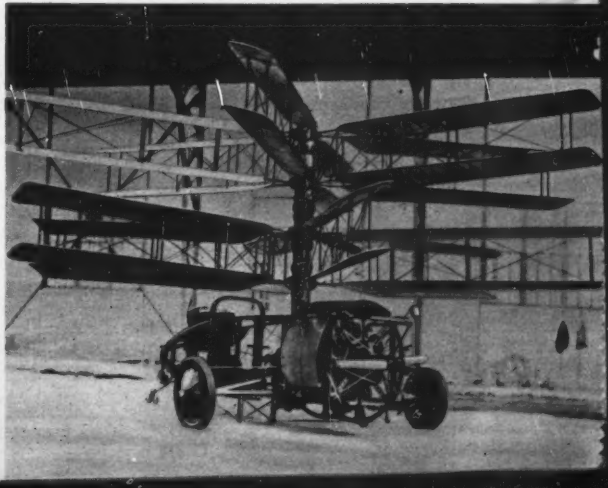
(1) *The Ornithopter*, in which the surfaces flap or oscillate. Mechanically it is difficult to achieve the correct wing movement; there are obvious difficulties in control, and the type can be ignored as being unlikely to result in practical aircraft.

(2) *The paddle wheel or cyclogiro*, in which the surfaces are mounted like the blades of a paddle wheel. Schemes which would appear to be satisfactory have been proposed, and at least two tested full-scale. They did not fulfil their original promise and were abandoned.

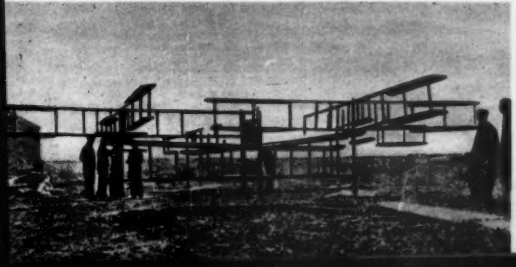
(3) *The helicopter*, in which the surfaces are mounted like the blades of an airscrew rotating about a substantially vertical axis. This type has always had more adherents than the others, and is the one which has now given us an entirely practical aircraft which can be put into the hands of operators, both civil and military. It is to this type that these articles are confined.

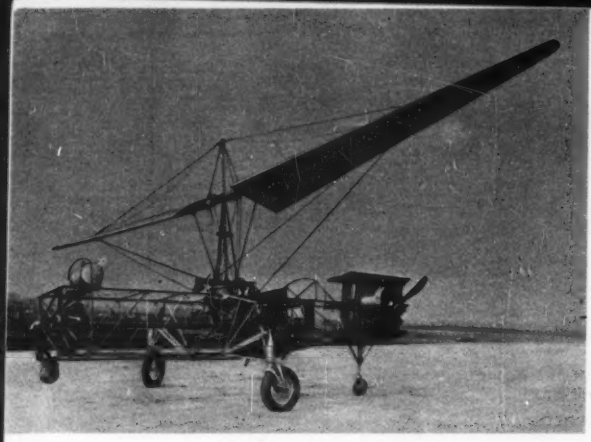
Since it is only in the last few years that the helicopter has become news there is a widespread belief that it is a new development. This is far from the truth, and indeed, direct-lift aircraft, including the helicopter, wer suggested long before the fixed-wing type. The story of man's desire to fly,

The Pescara helicopter, flown in France during 1923.



The 1907 Bréguet—first helicopter to lift itself and pilot.





Von Baumhauer helicopter of 1924—first with single main rotor and tail torque-compensating airscrew. Forerunner of classical Sikorsky types.

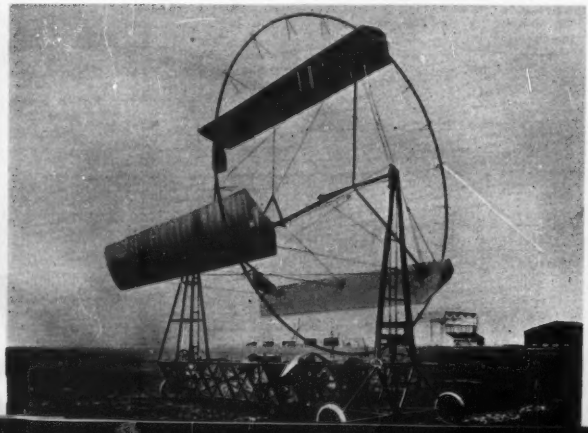
THE HELICOPTER...

and his efforts to copy the flying creatures, goes back far into mythology where, for instance, we have the story of Dædalus who made artificial wings for himself and his son Icarus, which they fastened to their arms with wax. Icarus flew too close to the sun, the wax melted and the wings fell off, so that he crashed to his death in the Icarian Sea, to which he gave his name. These tales are not all wholly imaginative, since there have always been brave experimenters, using elementary wings, who were prepared to hurl themselves from high places to prove their theories.

Later, the rotating-wing idea crept in, and the first helicopter—only a toy, it is true, and again popular with children of to-day—was the "flying top" described in Chinese literature long before the Christian Era. Towards the end of the fifteenth century Leonardo da Vinci studied bird and mechanical flight, and in his notebooks he left sketches showing flying machines, including one with an Archimedean screw rotating about a vertical axis. Experiments on flight continued throughout the next three centuries, chiefly with flapping-wing types, until 1784. In this year helicopter development proper can be said to have started with the demonstration of a model consisting of two contra-rotating systems on a common axis by Launoy and Bienvenu before the Academie des Sciences in Paris. This demonstration so intrigued Sir George Cayley the "Father of British Aeronautics" that he also, in the opening years of the nineteenth century, built model helicopters and put forward designs for a full-scale type driven by steam.

From then onward many helicopters were built, and at last in 1907, when light engines were available, a considerable degree of success was achieved by Louis Bréguet and Professor Richet. Their helicopter was the first to lift itself and its pilot, although it was not capable of controlled flight forward.

Moineau "paddle wheel," built in France about 1926.



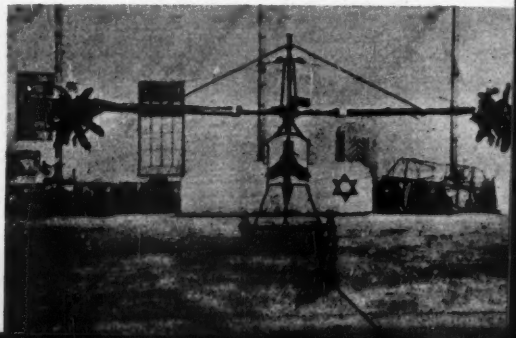
By this time, of course, fixed-wing aircraft had arrived. Thanks to the research energy devoted to it this class of machine has made phenomenal strides, but it has, and always will have, the great drawback of being critically dependent on speed for its support in the air, so involving the provision of long, expensive runways for take-off and landing, and introducing the hazard that inadvertent loss of flying speed, particularly near the ground, can end in disaster. Freedom from stalling in the ordinary sense of that term, and the benefits conferred by its slow-speed characteristics, are the very *raisons d'être* of the helicopter, and there have always been people working on the problem, each contributing something and slowly working towards the practical helicopter as we know it to-day. Among them, to mention but a few, have been Cornu, Oehmichen, Isacco and Pescara in France, de Bothezat in America, Florine in Belgium, D'Ascanio in Italy and Asboth in Hungary.

Why, then, has it taken so long for the practical helicopter to emerge? The truth is that the early workers had not appreciated the problem as a whole, and in most cases only appear to have been concerned in developing enough lift to sustain the aircraft, a problem which in itself is quite simple. The helicopter rotor, so far as vertical flight is concerned, is simply a large-diameter, slowly rotating, variable-pitch airscrew and follows ordinary airscrew theory. It was in the demanded characteristics of stability, control, forward flight and safety in the forced landing that the difficulties arose; and even when these were solved there was a great deal of engineering development required on the rotating systems and their controls. Let us examine these in some detail:—

Forward Flight.—In the pure helicopter the propulsive force necessary to overcome the drag of the aircraft in forward flight is obtained by tilting the rotor(s), so obtaining a component of the lifting force from the rotors. In the gyrodine (mentioned later) a separate airscrew contributes to the propulsive force. This is beneficial in that the axis of the rotor is not tilted forward, at any rate to the same extent, with a consequent reduction in vibration at high speed.

In flight, with a velocity of translation, we have the difficulty that the blade, which is advancing into the wind, has a very much higher relative velocity than the retreating blade, and so experiences greater lift. In the absence of some special arrangement this inequality of lift on the two sides gives rise to an inconvenient overturning moment. There are several expedients by which we might surmount this difficulty: (a) We could, for instance, balance the changing relative velocity by a cyclic change of blade velocity, i.e., slowing up the advancing blade, and *vice versa*. This obviously involves very high angular accelerations on the blades and is not practicable. (b) Alternatively, we might vary the blade area or telescope the blades periodically, which is difficult mechanically and not very practical. (c) A simple solution is to use pairs of systems rotating in opposite senses; they can be superimposed side-by-side, or in tandem. All these arrangements have been used with more or less success. (d) We can compensate for the changing resultant velocity in forward flight by a cyclic change in the lift characteristics of the blades, i.e., by flaps or other lift-controlling devices. This method has recently been used with great success. (e) We can "feather" the blades, i.e., change the blade-angle cyclically. This method has been used with considerable success, but it makes the blade struc-

Isacco's second "helicogyre." Each of the two blades carried an Anzani engine. (Test-flown by the author in 1928.)



PROGRESS

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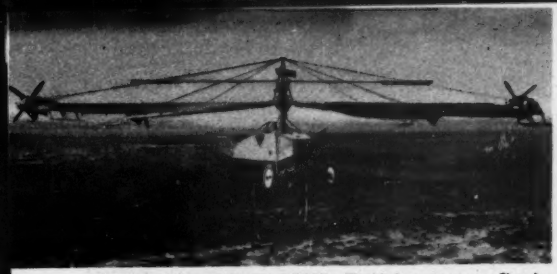
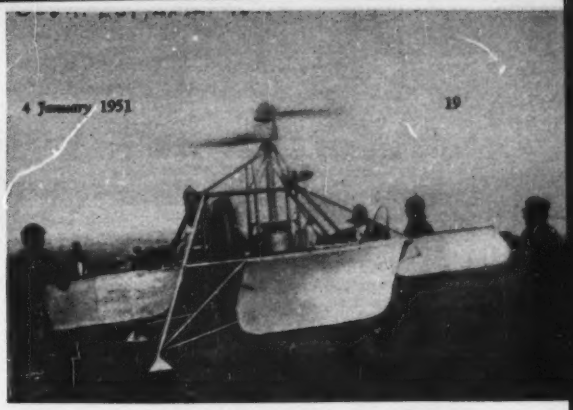


British-built Isacco helicogyre (1930). The blade engines were Cherubs, the nose engine a Genet. Note separate control rotor.



Asboth's fourth helicopter (1930). The machine is seen coming in to land, with the author at the controls.

THE HELICOPTER...

tural problem more difficult, due to the periodic bending moments at the blade roots. (f) Use can be made of articulated blades, i.e., blades mounted on hinges, so that they are free to "flap" and so automatically adjust their effective angle of incidence. The advancing blade flaps upward, so reducing its incidence and the air load on it, and the retreating blade flaps downwards. This principle was known in the early days of rotating-wing development, but it was not until Cierva rediscovered it and applied it to his Autogiro that its importance was appreciated. Unfortunately, it introduces periodic forces in the plane of rotation, with attendant vibration troubles, and it is necessary to introduce a second hinge, permitting freedom of movement in the plane of rotation. In spite of its drawbacks, however, it was the articulated blade which gave us the first practical helicopter and even today all helicopters in operation have this type of blade system. It has the additional merits of relieving the blade roots of the bending moment due to the air loads, and of reducing the effect of gusts.

Control.—In the early helicopters, control was often sought by having surfaces hanging in the downwash from the rotors, or by auxiliary variable-pitch airscrews mounted on outriggers about appropriate axes. The first arrangement is not good, because it introduces extra weight and drag and because the controls become inverted in the forced-landing case when the rotor is in auto-rotation and the airflow is reversed, being now upwards through the disc instead of downwards as in normal power-on flight. The second alternative, while giving good control, is poor because of the extra weight and drag and the mechanical complexity.

Here again, the gyroplane showed the way, either as in Cierva's Autogiro, where the whole rotor was tilted in the desired sense, or in the form developed by Hafner, in which the lift vector is tilted not by tilting the whole rotor, but by a cyclic change of the blade angles, which by tilting the tip-path plane achieves exactly the same result. The latter method is more appropriate to the helicopter, where the rotor is permanently driven from the power unit, since the tilting head in this case involves considerable mechanical difficulties. With rigid rotors using cyclic lift-control the lift vector, instead of being tilted, moves eccentrically, so giving a very powerful control.

Stability.—Stability is a big subject. It will suffice to say here that the ordinary single articulated rotor is not very good as regards its stability characteristics. These make it very tiring to fly on instruments under blind-flying conditions. The stability problem is now beginning to be better understood and stable rotors can now be designed. The superimposed type of twin rotor is unstable, while the articulated side-by-side, or tandem, arrangements are stable about the axis parallel to the line of the two rotors, but relatively unstable about the axis at right angles. The side-by-side type, using cyclic blade lift-control, is stable about all axes.

The Forced Landing.—Besides the articulated rotor and tilting-head control, Cierva's other great contribution to rotating-wing aircraft was the discovery of the high parachutal value of an auto-rotating rotor with the blades at small positive angles. In the event of power-unit failure in a helicopter all that is necessary is for the blade angles to be reduced, when the rotor will remain rotating, the aircraft then becoming a gyroplane, and a safe landing can be effected by using ordinary auto-rotative technique.

From this simple résumé, it will be seen that Cierva's Autogiro had almost all the elements necessary for a practical helicopter. Indeed, in its final form—the so-called "direct take-off" type—it was a helicopter for a few seconds at take-off; when the blades were put at small angles and over-revved by the engine, the engine then declutched, and the blade angles suddenly increased. The aircraft then jumped vertically as a true helicopter, using up the kinetic energy of the rotor. At the top of the jump the blades were automatically returned to the normal auto-rotative incidence and the aircraft continued in flight as a pure autogiro.

Hafner's gyroplane was nearer to the helicopter in that the pilot was given manual control over the blade angles. In this case a helicopter landing, as well as take-off, could be effected by suddenly increasing the blade angles in the glide when a few feet from the ground, and so using the kinetic energy of the rotor to touch down with zero velocity and no run.

Other than arranging to put the whole of the engine power into the rotor, and providing control over blade angles, so that the pilot can choose the angle appropriate to any desired flight régime (or arranging for some automatic device, such as a constant-speed unit, which would maintain the blades at the correct angle whatever be the applied power), only one other thing remains—to derive a helicopter from the basic gyroplane. This involves torque correction.

Torque Correction.—Whenever we have a single rotor driven through a transmission, we have a torque reaction, as a result of which the fuselage tends to rotate about the rotor axis in the opposite sense to the rotor. The methods which can be used for balancing this torque reaction are characteristic and can be used to classify helicopter types:—

(i) *Two Co-axial Rotors.*—Most early helicopters were of this type, which has the double merit of eliminating the rolling moment due to forward flight, and balancing-

Cierva C.19 Mk. IV two-seater Autogiro, circa 1931.

Bréguet Gyroplane of 1936—the first to set a real standard of helicopter performance.

THE HELICOPTER...

out torque reaction. While Louis Bréguet built a most interesting helicopter of this type in 1936 and more highly developed types are flying today, it is not a very good configuration, since its stability is poor, and the rotors have to be separated by a gap to remove all danger of the blades fouling, particularly when starting up, or stopping the rotors in high winds or gusty conditions.

(ii) *Twin Rotors, Disposed Laterally or in Tandem.*—The side-by-side arrangement is unstable longitudinally when the blades are articulated, and the outriggers involve added weight and drag. This arrangement can be made stable longitudinally by using rigid rotors with cyclic blade lift-control. The articulated arrangement, however, in the Focke Achgelis type 61, demonstrated in 1937, gave the first really practical helicopter, which held the following records recognised by the F.A.I.:—altitude, 8,000 ft; time of flight, 1 hr 20 min 50 sec; speed over 20-km course, 76 m.p.h.; distance in a closed circuit, 50 miles; maximum distance flown across country, 143 miles.

The tandem arrangement would appear to be better, since weight and drag are saved, and it promises to be one of the best configurations for the bigger helicopters of the near future, where the construction of large-diameter single rotors would offer a big structural problem.

A variation of the side-by-side arrangement consists in closing the hubs of the two rotors together on inclined axes, so that the blades intermesh. This reduces dimensions and saves the weight and drag of the outriggers, and is more stable than the normal side-by-side arrangement. Several satisfactory aircraft of this type have been built, both in America and in Germany.

(iii) *Single Main Rotor, with Auxiliary Rotor at the Tail.*—This is the most successful type to date. It was first used by Von Baumhauer in 1924 and developed to a practical stage during World War II by Sikorsky in America. It has given a great stimulus to the helicopter movement. Most helicopters flying today, even up to ten-seater size, are of this type, the Sikorsky S.51, built in this country under licence by Westland Aircraft, Ltd., perhaps being the best-known, and the one with most operational experience behind it.

One form of this arrangement, which is intermediate between the helicopter and gyroplane, was suggested by the Cierva Company before the war, and has been called a "Gyrodyne." In this form, which has been built by the Fairey Company, the torque-balancing airscrew is arranged outboard, and contributes to propulsive thrust. It wastes more power when hovering than the tail rotor, but the type is more efficient in high-speed flight, and is less prone to vibration at high speed.

(iv) *Single Rotor, with Surfaces in the Downwash.*—Before the war Hafner proposed a type in which the fuselage was of twisted aerofoil shape and the air forces provided a couple balancing torque-reaction, without any power loss being introduced. Due to the war, this type was not, in fact, built.

Cierva W.9, with jet reaction at the tail for torque compensation.

(v) *Single Rotor, with Jet Reaction at the Tail.*—In order to eliminate rotating surfaces at the tail a lateral jet reaction device has been proposed. Several aircraft with this feature have been developed, one of them by the Cierva Autogiro Company in this country.

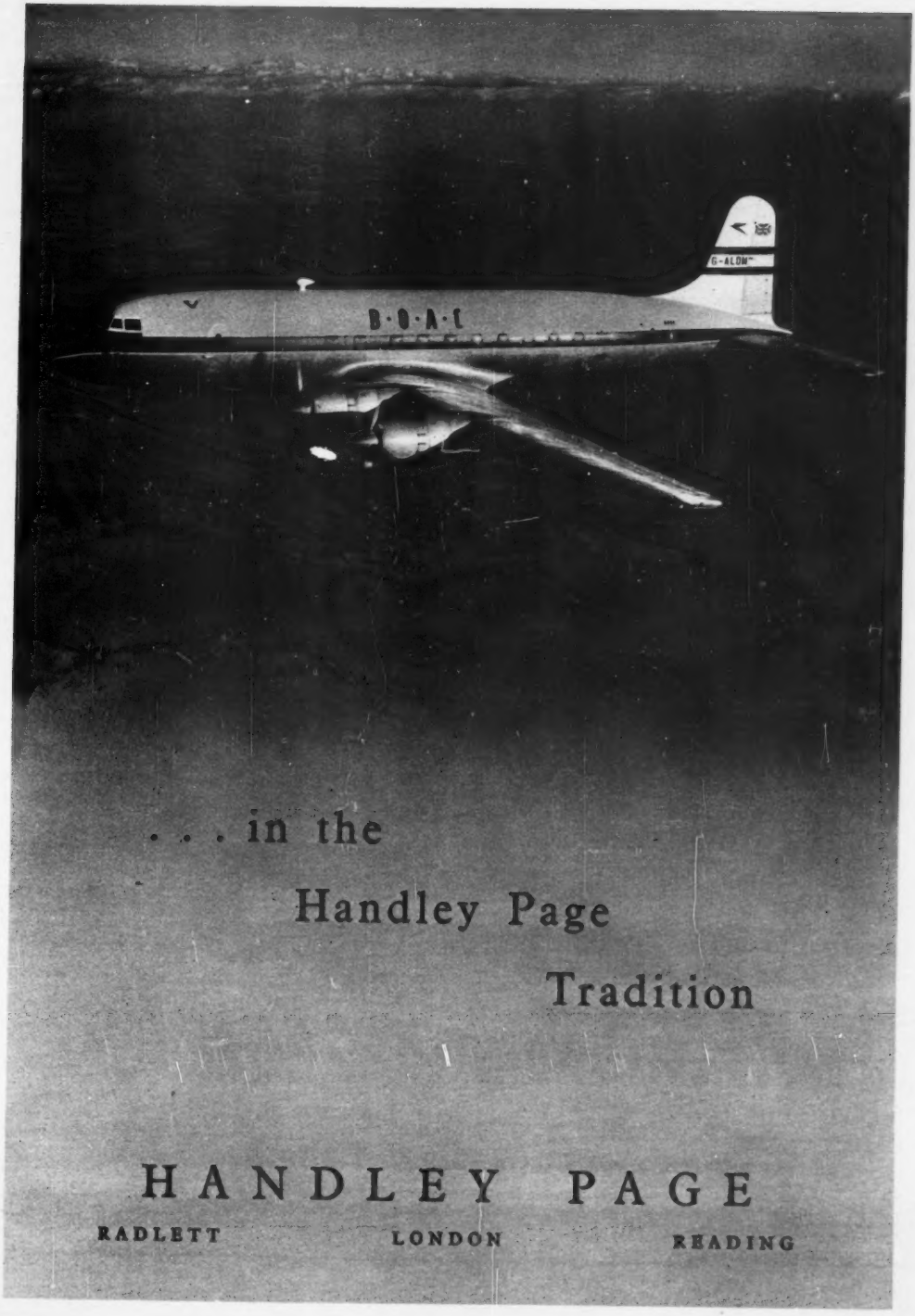
(vi) *Single Rotor, with Power Units in the Blades.*—It has always been recognized that if the rotor could be driven from within itself there would be no torque reaction, and the troublesome correcting devices would be unnecessary. Jet reaction at the blade tips would be the ideal drive, since the tip speed would be high, with corresponding high jet efficiency. Several types are under development, but at the moment, in the absence of suitable jet units, the fuel consumption is very high. Even so, up to about two hours' duration, the type can carry as much pay load as its competitors with normal power units. Some early helicopters (as for example, Isacco's "Helicogyre") used normal power units mounted on the blades to achieve this ideal, but engine difficulties were encountered due to faulty carburation and oiling-up troubles caused by the intense centrifugal field, and, in addition, owing to the varying relative velocity the airscrews of the wing engines were operating under poor conditions.

Vibration.—One further problem which ought to be mentioned is that of vibration. It must be realized that the aerodynamic forces on a helicopter rotor are periodic in forward flight. The articulated rotor is a particularly bad offender in this respect and this fact explains the development now taking place on rigid rotors. One of the major sources of vibration is the periodic stalling of the blade tips. As will be appreciated from a later article, when the rotor disc is tilted forward for propulsion there is an added axial flow through the disc. This increases with forward speed and changes the blade angle of attack unequally from root to tip, the least affected being the tip, where the velocity due to rotation is highest. As a result, when the mean blade angle is increased to compensate for the axial flow, the blade angle at the tip becomes excessive, and at high forward speed the tip section will stall on the retreating blade, where the angle of attack is already high due to blade flapping or cyclic feathering. This periodic stalling not only impairs the efficiency of the rotor, but limits the operating speed due to the vibration which it causes.

(*To be continued*)

Twin-engined Kellett XR-10, with intermeshing rotors.

Piasecki PV3, single-engined, with tandem rotors.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CIVIL AVIATION NEWS

TEMPORARY ACCOMMODATION : Siam Airways and Malayan Airways are both using marquees at Butterworth, Malaya, for passenger reception while the nearby runway on Penang Island is being repaired. They hope to return to Penang in April.
"Flight" photograph.

GOOD PROSPECTS FOR B.O.A.C.

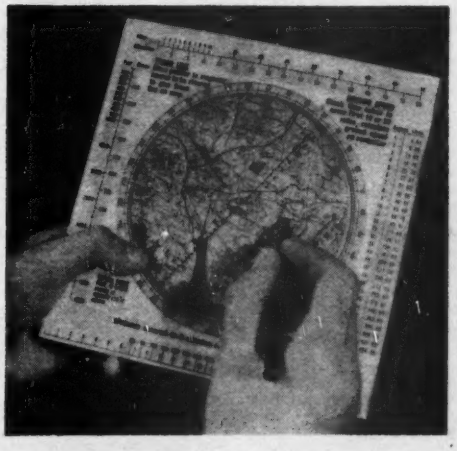
THE encouraging results of B.O.A.C.'s operations for the year ended October 31st, 1951, were last Sunday announced in a New Year message from the chairman to the Corporation's staff. Sir Miles Thomas revealed that the annual deficit had been reduced, as compared with the previous year, from £8,400,000 to £5,700,000. Annual output per employee had risen from 6,300 to 8,300 capacity ton-miles, while revenue per employee rose from £900 to £1,200. B.O.A.C. carried 180,000 passengers in this period, an increase of 30,000 on the previous year, and one which was achieved with an increase of 20,000,000 in the total capacity ton-miles offered.

Of the prospects for the current year—the occasion of the Festival of Britain—Sir Miles Thomas thought that given reasonably suitable world conditions, B.O.A.C. would undoubtedly achieve good results.

COCKPIT CALCULATOR

A COURSE-AND-DISTANCE calculator which should prove useful to many private pilots (and, no doubt, some commercial pilots also) has been designed and produced by Shell-Mex and B.P., Ltd.

Intended primarily as an aid to private flying under V.F.R. conditions, it consists of a double-faced engraved plastic square, of convenient size. On one side a rotating disc provides a quick reference for the courses and distances to nearly all British civil airfields likely to be used, while on the reverse side a circular section of map may be inserted to give an indication of the first ten miles (or 20 miles—according to the scale used) of the course to or from the base airfield. A table of conversion factors is also engraved on the instrument.



The pilot's calculator developed by Shell-Mex and B.P., Ltd. (and described above), is seen to be a compact and neat device of convenient size ; at the same time it is considerably easier to read than are most similar instruments designed for cockpit use. *"Flight" photograph.*

The calculator has been used by Shell pilots for a number of years and has proved so useful that the company has decided to make it available to all at a cost of 10s.

T.W.A. BUYS THE "1049"

T.W.A. has announced its intention of purchasing ten new L-1049 Super Constellations from the Lockheed Aircraft Corporation. They will cost nearly £6,000,000 and are scheduled for delivery in the spring of 1952. The company is already operating more Constellations than is any other airline and, when delivery of the new aircraft is completed, T.W.A. will have a fleet of 76 machines of this type.

The Super Constellation (notes on which have appeared in recent issues of *Flight*) is 18ft longer than the standard version and has a gross weight of 120,000 lb. The increased a.u.w. is, in part, offset by the additional power from the ejector exhaust system fitted to the Wright C18CA-1s which will power T.W.A.'s aircraft. Maximum cruising speed at normal a.u.w. is just under 310 m.p.h. In addition, the Super Constellation has an operational ceiling 5,000ft above the present limit for the standard versions. For domestic operation the "Super Connies" can accommodate up to 75 passengers, while for transatlantic services it is thought that passenger capacity will be about 60. Other characteristics are similar to the L-749A.

It seems most likely that the basic 1049 version will be used—at least initially—on T.W.A.'s domestic routes and that further orders may be for the L-1049C with compounded engines; for these latter machines a much later delivery date is being quoted.

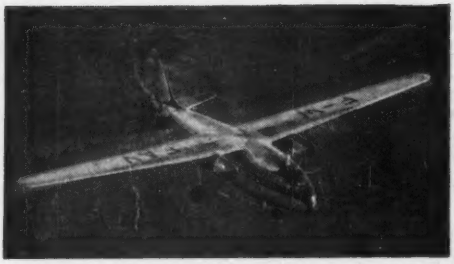
Even when powered with the CA-1 engines the 1049 will have a better performance than most other types outside the pure jet field. With a capacity payload of approximately 17,000 lb, a maximum range of 3,300 miles is quoted with a three-hour reserve. With a reduced payload of 12,250 lb, still-air range with reserves is 4,200 miles, with a block speed of 300 m.p.h. for the London-New York flight.

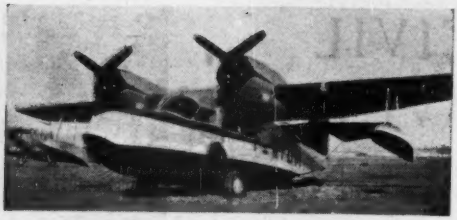
The announcement of the T.W.A. order brings the present 1049 backlog to about £18,000,000. Other orders already made known are those for K.L.M., Eastern Airlines and the U.S. Military Air Transport Services.

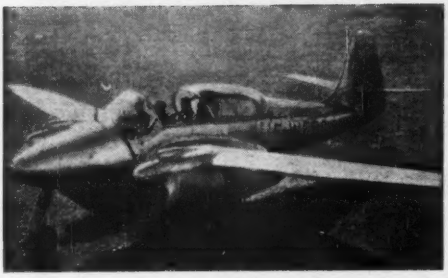
PAN AMERICAN'S TRAFFIC RECORD

HAVING enjoyed—like so many other operators—a full share of the increasing prosperity which was apparent throughout the world's air transport industry last year, P.A.W.A. recorded a greater volume of traffic than ever before in its 24-year history. The year's work involved the carriage of more than a million passengers in addition to 50,000,000 lb of cargo.

This record—which does not include work done for the armed forces—was all the more notable in that it was achieved at a time when one-tenth of the company's four-engined fleet was







AVIONS D'AFFAIRES : An enterprising demonstration tour, which was also made the occasion for completing a number of important tropical trials, was recently undertaken by a formation of three French civil prototypes. They were the Fouga C.M. 100 (top left) ; the S.C.A.N. 30 amphibian (top right) and the Morane 700 (lower left). Following a route which involved some 22,000 km of flying over difficult country, they visited, as the diagram (right) shows, many of French West Africa's outlying air-strips, between which their manufacturers hope they may soon be plying commercially. Spares and ground equipment were carried in an accompanying DC-3 and the tour was organized by the French Secretariat of Civil and Commercial Aviation.

CIVIL AVIATION NEWS . . .

devoted exclusively to the Korean airlift. On the airlift itself, Pan American, acting as "prime contractor" with a team of four other companies, was responsible for the carriage of 17,424 troops and over 4,000,000 lb of essential military freight to Korea.

During the year the company increased the size of its Stratocruiser fleet from 20 to 29 and placed an order for 18 DC-6Bs. In 1950, also, its activities included the inauguration of reduced-fare tourist services to Bermuda and Panama. Negotiations are still in progress to obtain permission to extend such services on a year-round basis, from the United States to points in Europe.

U.S. AIRMAIL

AS a result of a recent proposal by the American railway companies to increase mail rates by 95 per cent, U.S. Post Office officials are reported to be re-examining the possibility of transferring the major portion of mail loads to the airlines.

Interest is centred particularly on the current trials of the prototype Convair XC-99, whose possible application as an airborne "postal station" has been considered for some time. The manufacturers have estimated that, with its capacity of 16,117 cu ft, and its ability to lift 100,000 lb of payload, the aircraft could be used commercially between New York and Chicago at a direct operating cost of only 4.7 cents per ton-mile, and between Chicago and New Orleans or Los Angeles at 4.6 cents per ton-mile. The XC-99 is at present undergoing trials as a military freighter, in the course of which it has hauled more than 1,000,000 lb of cargo in its first seven weeks of operation. These flights included a transcontinental trip with 85,000 lb of payload.

The Post Office is now considering the practicability of obtaining the XC-99 on loan from the U.S. Air Force for trials with heavy mail loads between major distribution centres throughout the United States.

Last year, American surface-transport services recorded 3,030,000,000 ton-miles of mail, for which they received $253,000,000. The airlines recorded 40,000,000 ton-miles and were paid $54,000,000. The Assistant Postmaster-General is reported as saying that "the gap between air and surface transport, though still wide, is now closing" and that "initiative on the part of the airlines could close it completely."

Although the four largest scheduled operators are now receiving mail rates of from 50 to 60 cents per ton-mile, one company, Slick Airways, has already offered to carry mail at only 15 cents per ton-mile.

BEAT-YOUR-NEIGHBOUR

FOLLOWING the ban imposed by United States authorities in Germany on Czechoslovakian air services to Zurich and Rome, Czechoslovakia has now notified the Swiss Government that flights to Prague by Swiss aircraft "must be reconsidered in the light of the U.S. action." It is understood that a similar note has also been sent to the Italian Government.

It will be recalled that, as reported in *Flight* of December 14th, flights by Czechoslovakian aircraft over the U.S. zone of Germany were banned by the American High Commissioner on November 27th, after such machines had allegedly violated flight regulations when crossing Western Germany and had made more than 50 unauthorized trips over that territory while carrying delegates from Sheffield to the Warsaw "Peace" Congress.

The notes to the Swiss and Italian governments are thought to be based on a demand for a continued share in the operational revenue, even though Czechoslovakian aircraft are no longer flying on these two routes.

B.E.A.'s flights into Prague are so far unaffected. In fact, the Corporation stands to gain a certain amount of traffic from the recent Czech refusal (mentioned on p. 5) to allow British, Canadian and American diplomats to enter or leave Czechoslovakia in private or military aircraft. Since no American airline is licensed to operate in Czechoslovakia, American diplomats will in future have to use either B.E.A. or C.S.A., the Czech State airline.

BREVITIES

IT was disclosed at a recent meeting of the Scottish Aerodromes Board in Glasgow that, following a recommendation from the M.C.A., plans for the proposed new terminal buildings at Renfrew Airport are to be prepared forthwith by an Edinburgh architect.

* * *

At the opening of a new airport at Devonport, Tasmania, the Australian Minister for Air, the Hon. T. W. White, M.P., revealed that more than 180,000 people, or three-fifths of Tasmania's population, fly across the Bass Strait every year. At a cost of £A1,500,000 a further airport is soon to be built at Cambridge, near Hobart.

* * *

It is reported from Greece that a committee of senior Air Force officers is to co-operate with American technicians in evolving new plans for the improvement of Athens airport. A consultant is also at work on a study of the possible reorganization of Greece's airline system.

* * *

A S.A.S. DC-4, *Olav Viking*, which is used on special trans-atlantic freight services, recently flew non-stop from New York to Copenhagen in 17 hr 14 min. Incidentally, Miss Margaret Gudmundsdottir, who was elected "Miss Airways of 1950," at London Airport last summer, has now resigned from Iceland Airways, Ltd., and is serving as a stewardess on S.A.S.'s New York flights.

* * *

International Aeradio, Ltd., has secured a new contract by which the company will be responsible for the installation and maintenance of all ground radio equipment in East African territories. A team of technicians has now been assembled for the project, which involves a total of some 28 airfields, including the international airport at Eastleigh. Administration will be handled by the newly created International Aeradio (East Africa), Ltd.

* * *

M.C.A. *Information Circular No.* 122/1950 draws attention to the range of emergency conditions under which use may be made of the V.H.F. channel on 121.5 Mc/s. In addition to its normal distress functions it may also be used to provide a V.H.F. link between aircraft and civil or military surface services engaged in search and rescue operations; to provide air-to-ground communications when the failure of airborne equipment prevents the use of the usual channels; and to provide an R/T link between aircraft and ocean-station Vessels when no other channel is available.

* * *

Announcing the fact that United Air Lines—America's major internal operators—carried over 2,500,000 passengers last year, Mr. W. A. Patterson, the company's president, forecast that U.S. scheduled operators will achieve further substantial traffic increases this year. Pointing out that air fares are still at approximately pre-war levels while prices of virtually all other products and services have undergone considerable increases, Mr. Patterson emphasized that the continued stability of passenger rates would be one of the principal factors in bringing about further improvements on the considerable progress made in the past year. "Military contract activities, however," he said, "can radically alter this traffic forecast." In December U.A.L. declared their first dividend since 1946.

About one thousand orphans of from six months to eleven years in age have been flown from the mainland to an island sanctuary off South Korea in fifteen twin-engined American transports.

* * *

Newly elected vice-president and comptroller of Panagra (Pan American-Grace Airways) is Mr. Kenneth A. Lawder. The president, Mr. Andrew B. Shea, made this announcement before the Christmas holiday.

* * *

Bharat Airways, Ltd., recently extended their Far Eastern service from Bangkok to Singapore. Initial frequency entails a weekly Skymaster flight; aircraft leave Calcutta just before midnight on Fridays and return on Sundays.

* * *

P.A.W.A. have concluded a contract with the U.S. Air Force to give training to flying personnel of the Military Air Transport Service on the Dehmel flight-simulator. Since this device was put into operation in November, 1948, it has been used in the training of 102 complete crews.

* * *

With the recent addition of four newly purchased DC-4s to their trans-Pacific fleet, C.P.A. are now using a total of five four-engined machines on international routes between Vancouver and the Antipodes, Tokyo and Hongkong. Since early September C.P.A. have had to provide two services weekly carrying capacity loads of United Nations personnel to the Korean theatre of war.

* * *

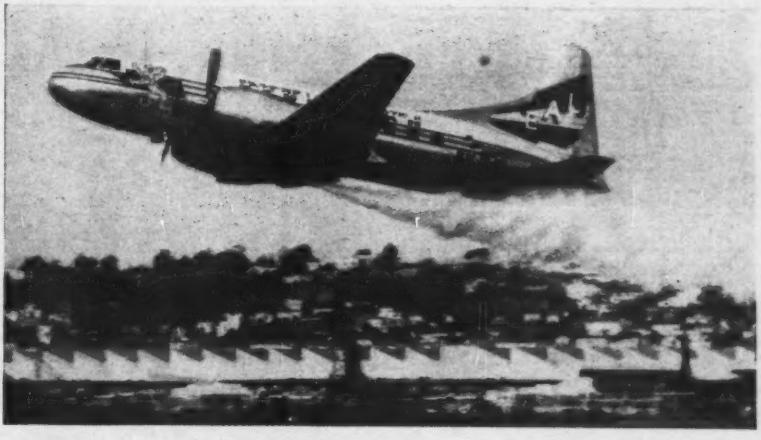
In spite of the fact that events in Korea are said to have had an adverse effect on traffic, particularly that originating in America, Swissair reports considerably improved results for the first nine months of 1950. The total of passengers carried was 150,482, as compared with 119,428 in the corresponding period of the previous year, while the amount of freight lifted rose from 1,003,720kg to 1,490,379kg. The increase in mail traffic was in similar proportion.

* * *

S.A.S. has announced a new system of "group fares" by which each passenger travelling in a party of 15 or more adults by the same routeing to the same destination may obtain a 10 per cent discount on his ticket. The scheme, which is effective from tomorrow, January 5th, is applicable when passengers are travelling between most European countries and is conditional on the organized party having a common interest in travelling together other than that of qualifying for the discount offered.

* * *

The General Electric Co., Ltd., has received an order from B.E.A. to supply 525 electrically heated food- and liquid-containers, which will be fitted as standard equipment in all the Corporation's aircraft. The containers are insulated metal boxes, approximately 16in high × 8in square; achievement of high thermal efficiency has enabled the power consumption of the heating elements to be kept down to only 200 watts. Each



AFRICA MODERNIZES: In these pages last week we gave news of the delivery of Convairliners to Ethiopian Airlines, Inc. One of these machines, already sporting the company's gay markings, is seen during a recent demonstration of single-engined take-offs with JATO (fitted as standard equipment) at San Diego, California. Each of the aircraft will make a 9,000-mile delivery flight.

CIVIL AVIATION NEWS . . .

container may be loaded with 12 plates or 1½ gallons of liquid; the weight of each unit is approximately 9lb.

* * *

The Venezuelan State-owned airline, Linea Aeropostal Venezolana, intends to inaugurate weekly round-trip Constellation flights from Maiquetia to Lima, Peru, as soon as landing rights have been granted by the Peruvian Government. The announcement follows the successful completion of eight test flights which have already been made on this route. At present the route is served by the Peruvian airline Andes, with an overnight stop at Panama; L.A.V., however, intends to fly the route overland and without any intermediate stopping point.

* * *

The Public Enquiry into the accident to B.E.A.'s Viking G-AHPN, which crashed at London Airport on October 31st, will open on Monday, February 19th, at the Royal Courts of Justice in London. The enquiry is being conducted by Sir Walter Monckton, K.C.; he will be assisted by G/C. S. W. R. Hughes, O.B.E., A.F.C., Deputy-Director of Operational Requirements at the Air Ministry, and by Capt. N. S. Head, D.F.C., a senior captain of Airwork, Ltd.

* * *

Statistics compiled by the Australian Department of Civil Aviation reveal a continued upward trend in all phases of airline activity in that country. During the financial year ended June 30th airlines operated over a larger network and carried more passengers, mail and freight than ever before. The most spectacular rise was seen in the amount of mail carried, 1,316,795 ton-miles being recorded. This represented an increase of 56.3 per cent over the total for the previous year and was accounted for mainly by the emergency flood-services flown in New South Wales and Queensland, by a coal strike and by Christmas mails. The domestic network now totals 72,078 miles.

* * *

American Airlines have announced a further order for three DC-6Bs; they will cost, including spares, about $3,500,000. The company already has 11 aircraft of this type on order and delivery of the first is expected in February. The company, incidentally, has now succeeded in obtaining authorization to operate a non-stop passenger schedule between New York and Toronto.

* * *

Preparations are now being made to carry out a survey of a possible Pacific route from Australia to South America. The Catalina to be used on the survey is now being given a complete C. of A. overhaul at the R.A.A.F. base at Rathmines. On the flight it will be commanded by Capt. P. G. Taylor, who is now arranging for 2,500 gallons of petrol to be available at Easter Island. Capt. Taylor, a T.O.A. pilot, was recently awarded the Johnston Memorial Trophy for Air Navigation.

PIPER TRI-PACER: Such is the appropriate designation of the latest version of this American four-seat sporting machine, now fitted with a sturdy-looking tricycle landing-gear. During the development work on the PA-22, as this conversion is also known, several prototypes were subjected to more than 4,000 landings and 3,000 miles of taxying—the equivalent of 15 years of normal private-owner operation. The Tri-Pacer has a steerable nosewheel, and rudder and aileron controls are interconnected. Empty weight is only 30lb greater than that of the standard version.

R.Ae.C. AVIATORS' CERTIFICATES

BELOW is a further list of R.Ae.C. Aviators' Certificates, for the period from September 8th to October 20th, 1950. The previous list (August 15th to September 8th) appeared in *Flight* of December 21st, and we hope to publish further names in an early issue.

No.	Name	Club or School	Date
26,745	John David Watt	Southend Municipal F.S.	8.9.50
26,746	Maung Tin Htut	Portsmouth Aero Club	8.9.50
26,747	Robert Hewitt	Qualified Service pilot	8.9.50
26,748	Sheikh Rashid Ahmad	Air Service Training, Ltd.	8.9.50
26,749	Roger Brading	Exeter Aero Club	8.9.50
26,750	Peter Brighton	Cambridge Aero Club	8.9.50
26,751	Louis William Dowdall	South Coast Flying Club	12.9.50
26,752	Owen Peter Nicholas ...	South Coast Flying Club	12.9.50
26,753	Hugh Rose	Cambridge Aero Club	12.9.50
26,754	C. L. I. Muntz	London Aeroplane Club	12.9.50
26,755	John Henry Lemon	London Aeroplane Club	12.9.50
26,756	Peter John Birkett	London Aeroplane Club	12.9.50
26,757	David Leonard Craig	Airways Aero Club	12.9.50
26,758	Charles Rayner Hutchinson ...	Denham Flying Club	13.9.50
26,759	Roy Anderson Laing	West London Aero Club	14.9.50
26,760	Richard Charles Gilpin ...	Northants Aero Club	15.9.50
26,761	Stuart Robert Bacon	Cambridge Aero Club	15.9.50
26,762	Anthony Darley Gough ...	Portsmouth Aero Club	15.9.50
26,763	Donovan Barling Walker ...	Herts and Essex A.C.	18.9.50
26,764	James Michael Drummond ...	Portsmouth Aero Club	18.9.50
26,765	James Thomas Dennis Holt ...	West London Aero Club	19.9.50
26,766	John George Kemp	Herts and Essex A.C.	19.9.50
26,767	Gholamreza Amir Hushang Kohan	Air Service Training, Ltd.	19.9.50
26,768	Ian Gerry	Hampshire A.C.	22.9.50
26,769	John Hubert Saberton	Service pilot u/t	22.9.50
26,770	Robert William Owen	Service pilot u/t	22.9.50
26,771	Donald William Sissins ...	Service pilot u/t	22.9.60
26,772	William Frances Anthony Haines	Cardiff Aero Club	23.9.50
26,773	Eric Edward Pick	Hereford Aero Club	23.9.50
26,774	Ross Osborne Spencer Salmon...	Elstree Flying Club	23.9.50
26,775	Ronald Mochrie Cox	Marshall's Flying School	25.9.50
26,776	Sir William Leonard Stampe ...	Exeter Aero Club	25.9.50
26,777	William Edward Doyle Bousfield	Service pilot u/t	25.9.50
26,778	Laurence Alfred Jones	Rochester Flying Club	26.9.50
26,779	James Desmond Horne	West London Aero Club	26.9.50
26,780	Richard Dallas Noble	Portsmouth Aero Club	26.9.50
26,781	Morteza Gordakfan	Air Service Training, Ltd.	26.9.50
26,782	Edward Michael Smith	Exeter Aero Club	26.9.50
26,783	Robert Walter Houchin ...	Southend Flying School	27.9.50
26,784	Brian Ralph Anthony Cox ...	Qualified Service pilot	28.9.50
26,785	Noel Dennis	Qualified Service pilot	28.9.50
26,786	Donald McMillan Knight ...	Service pilot u/t	28.9.50
26,787	Arthur Adair McKernan ...	Service pilot u/t	28.9.50
26,788	Donald Charles Perch	Qualified Service pilot	28.9.50
26,789	Keith Emile Johnstone	Airways Aero Club	28.9.50
26,790	Cyril Reginald Hannigan ...	Qualified Service pilot	28.9.50
26,791	Roland Joseph Le Duc	Portsmouth Aero Club	29.9.50
26,792	Bennett Lee Jackson	Conversion from U.S. Licence	30.9.50
26,793	Rodney Reuben Carne	Denham Flying School	2.10.50
26,794	John Walker Borland	Strathtay Aero Club	9.10.50
26,795	Charles David Gordon Black ...	Strathtay Aero Club	9.10.50
26,796	Angus Clephane Mackenzie ...	Strathtay Aero Club	9.10.50
26,797	Robert Robertson Anderson ...	Qualified Service pilot	9.10.50
26,798	James Grant Sutherland ...	Qualified Service pilot	9.10.50
26,799	James Ross Weatherhead ...	Strathtay Aero Club	9.10.50
26,800	Maung Ko Ko	Air Service Training, Ltd.	9.10.50
26,801	Peter John Merrick	Rearsby Flying School	9.10.50
26,802	John Akerigg Allan	U.L.A.A. Experimental Group	9.10.50
26,803	Ronald Herbert Summerton ...	Herts and Essex A.C.	10.10.50
26,804	Claude David Millington ...	Qualified Service pilot	13.10.50
26,805	Malcolm Charles Noyce... ...	Service pilot u/t	13.10.50
26,806	Edmund Harvey Wright ...	Qualified Service pilot	13.10.50
26,807	Brian Kynaston Waugh ...	Qualified Service pilot	13.10.50
26,808	Terence Edwin Brand	Airways Flying Club	13.10.50
26,809	Akbar Fotouhi	Air Service Training, Ltd.	13.10.50
26,810	Gerard Ian Pereira	Air Service Training, Ltd.	13.10.50
26,811	Abass Ali Abdollahi	Air Service Training, Ltd.	13.10.50
26,812	Earl Gannon Rice	Surrey Flying Club	16.10.50
26,813	Peter Frederick Beresford-May...	Southend Municipal F.S.	19.10.50
26,814	Ralph Challice Rowe	Redhill Flying Club	20.10.50
26,815	Victor Dennis Woolley ...	Blackpool and Fylde A.C.	20.10.50
26,816	Hassan Alsbouyeh	Air Service Training, Ltd.	20.10.50
26,817	Edward Francis Twiss	Rochester Flying Club	20.10.50
26,818	Robert Stanley Hawkeswood ...	Midland Aero Club	20.10.50
26,819	Frederick Elton Ord	Newcastle - upon - Tyne A.C.	20.10.50
26,820	John Ward	Qualified Service pilot	20.10.50
26,821	Aung Soe	Air Service Training, Ltd.	20.10.50
26,822	Pyi Nyunt...	Air Service Training, Ltd.	20.10.50
26,823	Ihsan Qaqish	Air Service Training, Ltd.	20.10.50

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CONFERRING TO SPEED PRODUCTION

Executives and designers of the Hawker Siddeley Group meet regularly every two months. Here, conferring at Armstrong Whitworths' Baginton works, are (top left) Sir Frank Spriggs with Sir Roy Dobson; (bottom left) Sir Frank Spriggs, Mr. T. O. M. Sopwith, Mr. H. M. Woodhams, Mr. R. Jones and Mr. S. D. Davies; (above) Mr. W. S. Farren, Mr. H. Burroughes, Mr. H. T. Chapman and Mr. W. Sawtan. In the background is the 750-ton British Clearing press recently installed at Baginton for use by all member-companies of the Group.

THE SMITHSONIAN

THE Smithsonian Institution is a unique establishment, not only in America but in the world at large. Founded in Washington by the bequest of an Englishman, James Smithson, in 1846, "for the increase and diffusion of knowledge among men," the Institution covers an enormously wide field of interests. Among the activities embraced by the Institution is responsibility for the U.S. National Air Museum: it may be remembered that on December 17th, 1948, the forty-fifth anniversary of the first flight of Wilbur and Orville Wright at Kitty Hawk, the original aircraft that made the historic flight was returned to America from the Science Museum in London, where it had been reposited since 1928. The presentation of the aircraft was made by Mr. Milton Wright, nephew of Wilbur and Orville, who concluded his address in these words: —

"The aeroplane means many things to many people. To some it may be a vehicle for romantic adventure or simply quick transportation. To others, it may be a military weapon or a means of relieving suffering. To me it represents the fabric, the glue, the spruce, the sheet metal and the wire which, put together under commonplace circumstances, but with knowledge and skill, gave substance to dreams and fulfilment to hopes."

Details of the presentation ceremony are included in the report of the Board of Regents of the Institution for the year ended June 30th, 1949 (which we have just received), and quite aside from the historical importance attaching to the return of the Wright aircraft to America, the report is one of the most absorbingly interesting books we have encountered for some long time. Even the secretary's report—which, in fact, comprises a series of separate reports—makes fascinating reading, whilst the general appendix, comprising approximately two-thirds of the book, includes brief accounts of scientific discovery made by collaborators of the Institution; and memoirs of a general character or on special topics that are of interest or value to the correspondents of the Institution. Suffice it to say that all the contributions included in the general appendix are made by the men eminent in their specialized fields.

A representative selection of some of the papers included in the general appendix illustrates the variety of interests covered: *The Formation of Stars; The Origin of the Earth; The 200in Hale Telescope and Some Problems It May Solve; The Determinations of Precise Time* (contributed by Sir Harold Spencer-Jones, Astronomer-Royal); *The Elementary Particles of Physics; Recent Advances in Virus Research; Animal Behaviour; The Archaeological Importance of Guatemala; The Ronne Antarctic Research Expedition; The State of Science.*

PROTECTION DURING ASSEMBLY

APART from any question of appearance, it is, of course, highly desirable that the skins of modern high-speed aircraft should be kept free of scratches, and roughness due to corrosion or other causes.

However strict supervision may be a good deal of such damage is likely to occur while a machine is on the assembly line: offering-up of structural members, dropping of tools and scratching by boot-nails are among the commonest causes. In certain conditions, also, corrosion may take place.

Intended to prevent damage of this kind, a new temporary protective coating has been added to the range of preparations made by Corrosion, Ltd., Warsash, Hants. Known as Avigel 100 Plastic Peel, it is already in use by a number of constructors, and is being employed during the assembly of the de Havilland Comets.

A coating about 0.004in thick is applied in liquid form by spraying or brushing and dries in a few minutes to a tough, flexible skin which will, it is claimed, effectively protect the metal surface against abrasion, scratching or corrosion over a period of many months. At any required time it can be quickly peeled off by hand, revealing the surface in its original bright state. The film is transparent, so that identification marks can be read through it, and is normally green in colour, though amber, red, blue and clear grades can be supplied.

Attractive from the economy aspect is the fact that the stripped film can be re-dissolved in Avigel thinners and, if kept reasonably clean, used repeatedly.

The film is stated to be non-inflammable and to have effective electrical insulating properties.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Students and Test-beds

I AM very grateful to you for publishing Mr. M. M. Gates' letter (December 14th). His idea of our school sharing its test-bed facilities with London colleges is most valuable and will immediately be followed up by my company. We already do a little co-operation with two teaching establishments, but they occupy only a few hours a year. The School of Gas Turbine Technology must charge costs for such activities, and engine running is not a cheap matter: but the facilities are there, and they are, as Mr. Gates has rightly surmised, considerably underloaded.

W. E. P. JOHNSON,
Power Jets (Research and Development), Ltd.
London, W.1.

Fighter Armament

A FURTHER suggestion might, I feel, be added to F/L. Waterhouse's excellent letter in *Flight's* Correspondence page for Decmber 21st. In the category "Fighter versus bomber (long range)," he advocates the use of a "very heavy calibre non-automatic shell-gun; pilot to aim and fire, crew to reload." Recently I learned that just such a weapon is going into production in the U.S.A., namely, the 105 mm recoilless shell-gun. This weapon is loaded by hand, but none the less, according to the information, rate of fire is ten rounds a minute.

I would like to hear comments on the feasibility of adapting the gun to any standard fighter such as the Meteor or Avro Canuck, to be used either (a) as a tank-destroyer, or (b) for dispersal of bomber formations.

I should add that at present this weapon is designated as an infantry tank-buster, but I feel that a little imagination could convert it to a powerful air-to-air weapon.

London, S.E.11. EX-W/O, D.F.M.

Those Life-rafts

WITH reference to the correspondence on life-raft refinements (pneumatically stressed athwarts in dinghies, etc.) in recent issues of *Flight*, I recall that during my service in the R.A.F. I was lucky enough to be one of a party which "scrounged" two 4/5-seat rafts from a Flying Fortress which had occasion to make a crash landing in Guernsey. (The Fortress was a complete write-off.) As we had plenty of sea around us we used these dinghies quite a lot. The inflated walls or sides seemed to be of a double-bubble type, as was the seat or thwart.

This was in 1945, and goodness knows how long the Americans had had them before that, so I am afraid that Mr. F. E. J. Biles, in his letter published on December 14th, seems a little presumptuous in claiming the pneumatic thwart as his firm's own and entirely new idea—he states that their life-raft, or dinghy, incorporating the pneumatic thwart, was first demonstrated only some eighteen months ago.

I think we must give the Americans their due and admit they have managed to get a "first" first.

Sheffield, 12. A. E. CRAPPER.

Pilot Navigators

IN your issue of December 7th you published details of a scheme said to be operated by B.O.A.C. for the conversion of specialist navigators into pilots. This scheme was important enough to merit your editorial comment and has also been the subject of a news item broadcast by the B.B.C.

At this stage I propose to say no more than to express the personal opinion that the details given—particularly as to the numbers said to be involved and the progress made—are over-optimistic. As general secretary of the organization to which nearly every specialist navigator employed by B.O.A.C. belongs, however, I feel it my duty to point out that, with the full support of all our members, we have from the beginning emphatically opposed all suggestions that this key member of a modern passenger aircraft's crew should be dispensed with.

Our objections are based on the grounds both of safety and economy and were fully set out in a memorandum submitted to B.O.A.C. in September, 1948. Briefly summarized, the major points submitted were that developments in navigational technique made comparison with the pre-1939 era virtually valueless; that the principal causes of aircraft accidents analysed between 1946 and 1948 as occurring to civil aircraft were due to errors of judgment, of which none could be attributed to any specialist navigator; and that the natural tendency of the average pilot, no matter what qualifications he may have acquired, is to concentrate on his career as a prospective captain of aircraft, and consequently to tend to regard navigation as an additional, if necessary, duty.

The Secretary of B.A.L.P.A., in your issue of September 21st, states that: "The profession [of piloting] is becoming more and more specialized. . . ." Surely the present policy of B.O.A.C., if continued and fully implemented, will be to increase a pilot's work and responsibility and, as a direct consequence, tend to add to his liability to error—with all that that implies for the safety of his passengers and the reputation of his company. His burden in modern aircraft needs to be decreased, not increased.

D. S. TENNANT, General Secretary,
The Navigators and Engineer Officers' Union.
London, E.C.3.

Insects and Aerodynamics

THE letter from "Aeroapiarist" (*Flight*, December 21st) brings to public notice what has been a pressing private interest of mine since about 1945, when I correlated in my own mind the electron-microscopic appearance of the insect wing and a previous near-disaster of grossly lengthened take-off with the thinnest sputtering of partly melted sleet on the top wing surface of an aircraft.

I have had what one might describe as the usual "not interested," almost repressive correspondence with the highest official—which correspondence, of course, being an official myself, I would need permission to quote. Undaunted, however, I remain ever hopeful that insect-flight sagacity might have further (*cf.* halteres) human flight applications.

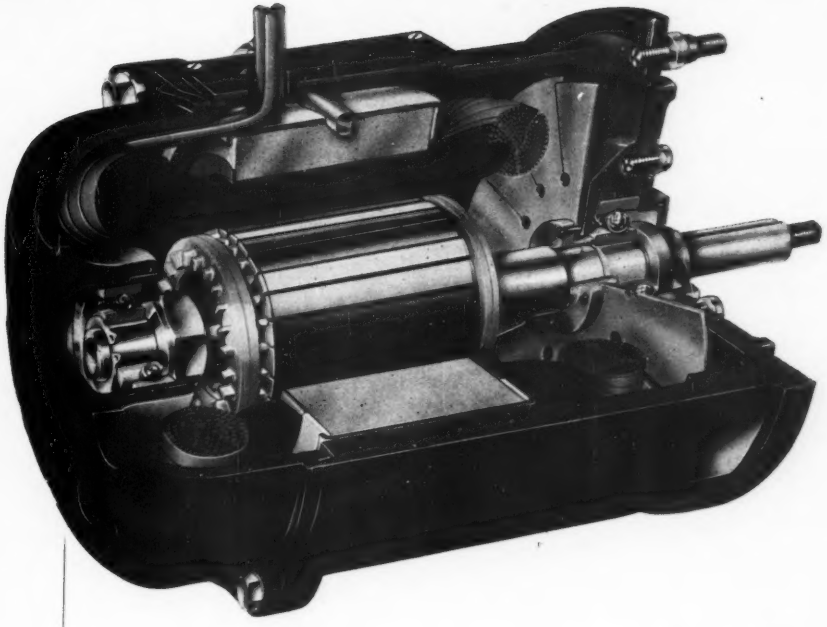
The insect wing seems, in fact, to consist of a very thin plane layer with hair-like outgrowths—a greater number to the acre than your published photograph suggests—so that it becomes somewhat like a miniature pile carpet. Is this not a wonderful natural economy—the insect moving, in wing beating, a volume of air (thanks to its cohesion to the hairs) equal in thickness to the whole of the "pile" of the carpet for a structure-weight limited to that of the plane layer and attached hairs? Do not "boundary layers" of air act as "solids" in the microscopic proportions here involved?

I would wish to make this formal claim to a reasonable share in the patent revenues accruing when airscrews, and perhaps control surfaces, are all made with non-smooth surfaces. I am left still wondering, however, whether weather protection, i.e., water-repellency, is not the basis of the insect's idea; perhaps, before claiming financial support for research I should force it to reveal its secret to me in my laboratory.

GRAHAME E. MURPHY, M.Sc., M.B., F.R.C.S.
London, S.E.15.

FORTHCOMING EVENTS

Jan.	5.	Institute of Navigation: "The Sensory Basis of Bird Navigation", by G. V. T. Matthews.
Jan.	6	British Interplanetary Society: Symposium on the Orbital Rocket.
Jan.	9.	R.Ae.C.: Film Show, Londonderry House.
Jan.	10.	R.Ae.C. (Brough): "Problems of High-speed Flight," by H. Davies, M.Sc., F.R.Ae.S.
Jan.	10.	R.Ae.S. (Weybridge): "High-speed Flying," by S/L. J. D. Derry, D.F.C.
Jan.	16.	R.Ae.S. (Belfast): "Landing Gear and Equipment," by H. G. Conway, M.A., F.R.Ae.S.
Jan.	17.	R.Ae.S. (Preston): "Aircraft Materials," by Dr. H. Sutton, D.Sc., F.R.Ae.S.
Jan.	20.	Aircraft Recognition Society: Hurricane Trophy Competition.
Jan.	23.	R.Ae.C.: Talk on Korea, by William Courtenay, O.B.E., M.M.
Jan.	23.	R.Ae.S. (Glasgow): Brains Trust.
Jan.	27.	Society of Licensed Aircraft Engineers: "Rocket Propulsion and Interplanetary Flight," by John Humphreys, B.Sc.(Eng.), A.M.I.Mech.E. A.F.R.Ae.S.
Jan.	30.	Society of Instrument Technology: "Machining of Small Instrument Parts," by K. J. B. Wolfe and P. Spear.
Jan.	31.	R.Ae.S. (Weybridge): "S. F. Cody," by G. A. Broomfield.
Jan.	31.	Royal United Service Institution: "Campaigning in Korea"—film and Commentary by William Courtenay, O.B.E., M.M.
Feb.	3.	British Interplanetary Society: "Interplanetary Orbits," by Dr. J. G. Porter, Ph.D., F.R.A.S.
Feb.	6.	R.Ae.C.: Colour Film of Korean Campaign, by William Courtenay, O.B.E., M.M.
Feb.	7.	Royal United Service Institution: "Flying-boats in war," by A. V-M. P. H. Mackworth, C.B., C.B.E., D.F.C.
Feb.	12.	Institute of Transport: Brancker Memorial Lecture—"Economic Aspects of Airline Operation," by Peter G. Masefield, M.A.(Eng.), F.R.Ae.S., A.F.Inst.A.E., G.Inst.Mech.E., M.Inst.T.



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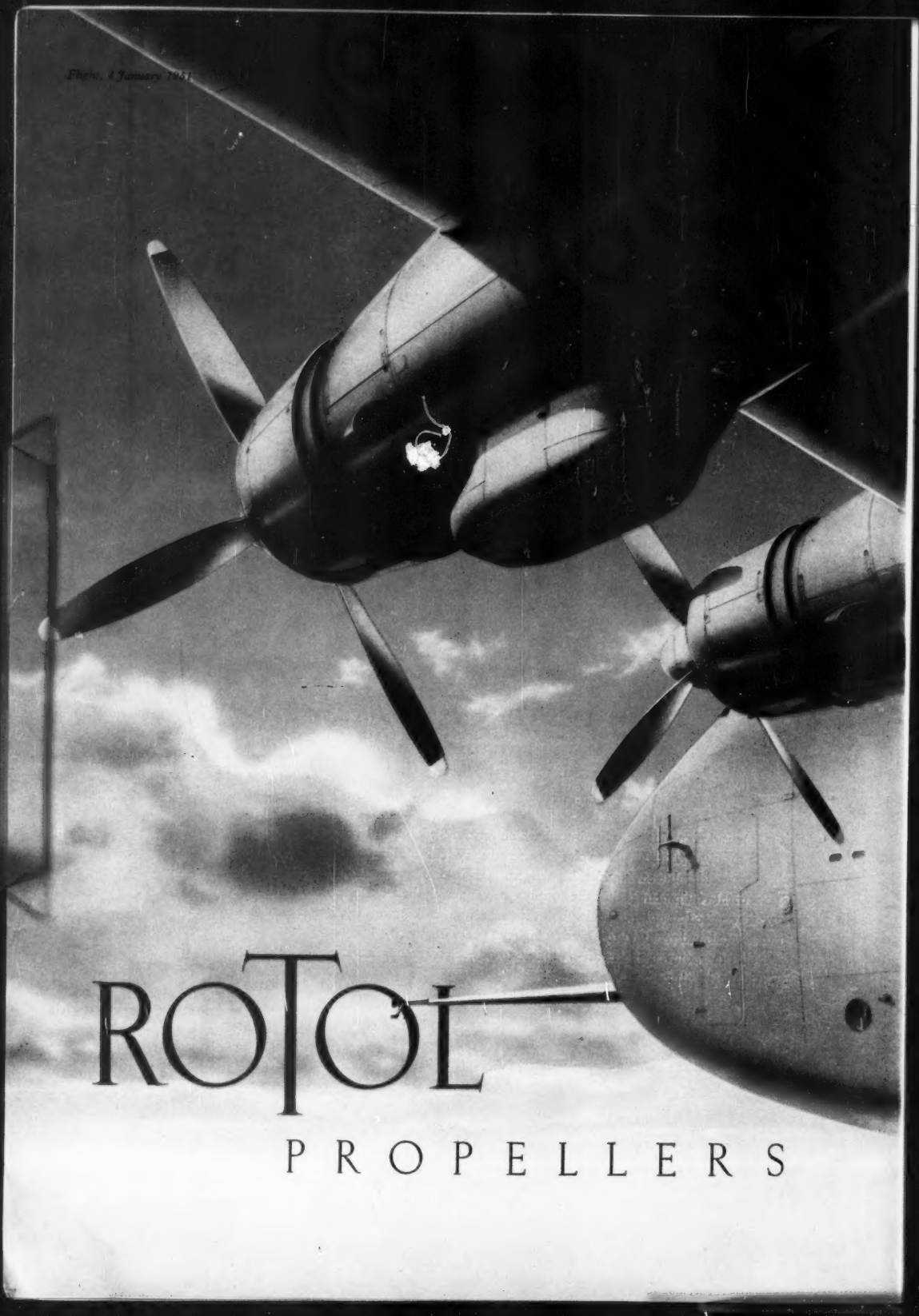
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SERVICE AVIATION

Royal Air Force and Naval Aviation News and Announcements

INSIDE INFORMATION : Evidently impressed, Malayan visitors study the bomb-bay and bomb-load of a Far East Air Force Lincoln during the third Singapore Air Day, held recently at Kallang airport. Types in the flying display included Meteors, Vampires and Brigands.

Night Search Technique

A NEW night-search technique for locating distressed crews of aircraft which have made emergency landings on land or at sea has been adopted by the R.A.F. The search aircraft, flying tracks spaced from 10 to 20 miles apart and at a height between 3,000 and 5,000 feet, according to weather, will fire a single green Very light at regular intervals. On sighting this signal the distressed crew will allow 30 seconds for the search aircraft to pass away from the glare of its own pyrotechnic, and will then fire two red Very lights, thus drawing attention to their position.

The new procedure takes advantage of the excellent visibility properties of pyrotechnics at night, and permits a search aircraft to fly at greater heights and over wider tracks. Success of the method depends on the co-operation of the distressed crew, and it will normally be used in conjunction with a day search. It is a development of a method evolved by No. 14 Squadron in Transjordan before the war. Tests of the system were made at the suggestion of Air Vice-Marshal T. C. Traill, C.B., C.B.E., D.F.C., who commanded No. 14 Squadron when the method was first used.

R.A.F. Holidays in Iraq

A LEAVE and rest camp for members of the R.A.F. serving at Habbaniya and other units in Iraq has been established in the Kurdistan Mountains, at Ser Amadia.

The camp, which is a few miles from the Persian frontier, provides fishing, hiking, donkey-riding and sun-bathing facilities in beautiful scenery and is reached after a journey by rail, road and mule. The R.A.F. holidaymakers, who leave Habbaniya in small parties, travel 50 miles by road to Baghdad, and then by train to Mosul. From Mosul they make a long road journey again, until the first mountain slopes are reached. Then they journey on mules up steep mountain paths to the camp.

"Flight" photograph.

SOON TO FLY VAMPIRES : A group of No. 80 Squadron, R.A.F. Left to right : F/L. Davies, F/L. Madigan, Sgt. Bennett, S/L. Tremlett, D.F.C. (C.O.), F/L. Jagger, Sgt. Williams, F/L. Redhead, D.F.M., Sgt. Hall, Sgt. Smith, F/L. White, D.F.C., F/S. Freeman and Sgt. Stally. The bell incorporated in the badge dates from the squadron's inception in 1917 when, as a Sopwith Camel unit, it was commanded by Major V. D. Bell. No. 80 now has Spitfires.

Netherlands Visitors

AIRCRAFT of the Royal Netherlands Navy will shortly begin several months' training with the Royal Navy in the United Kingdom. Two squadrons—from the carrier *Karel Doorman*—will operate here. No. 806 Squadron (Sea Furies) is expected to arrive on January 17th, and the Fireflies of No. 4 Squadron will fly to Eglinton, Northern Ireland, two days later. Ground crews and equipment for the aircraft are being sent in advance.

After a period of land-based training, during which the Dutch pilots will study British Naval air techniques and exercise with British squadrons, the Netherlands aircraft will go to sea during the summer in a carrier of the Home Fleet. Since the war, aircraft of the Netherlands Navy and Air Force have visited Britain during a number of Western Union exercises.

More Recruits for R.A.F.V.R.

THE Air Ministry announces that A.T.C. cadets who have learned to fly under the A.T.C. scholarship scheme can continue flying training with the R.A.F.V.R. while they await call-up for National Service. Their full-time service will then be spent in pilot-training up to operational standard and, on release, they will return to the V.R. or join Auxiliary fighter squadrons.

Another important concession concerns suitably qualified young men holding Private Pilots' Licences, who can now be taken on for pilot-training in the R.A.F.V.R. One hundred hours' solo flying experience was formerly the minimum qualification for pilot-membership. The next step, it is hoped, will be to admit *ab initio* pupils to the V.R., since many keen prospective members will be unable to afford the cost of instruction to private-pilot standard.

Drive for Safety

TO further the National Safe Driving Campaign, the Air Ministry has been encouraging R.A.F. mechanical transport drivers to enter the safe-driving competition organized by the Royal Society for the Prevention of Accidents. M.T. drivers who compete, and who complete the required period of driving without a blameworthy accident or a conviction for a driving offence under the Road Traffic Act of 1930, are eligible for the Society's awards. These are valuable to drivers

SERVICE AVIATION . . .

who intend to undertake driving as a career when they leave the Service, as the awards are recognized by civilian firms as setting a standard of safe and courteous driving ability.

Air Lift to Tokyo

A CANADIAN North Star transport of No. 426 (Thunderbird) Squadron, R.C.A.F., recently made the Squadron's hundredth trip to Tokyo from McChord Air Force Base, Washington, since the Canadian airlift began five months ago. The Squadron has now flown over 6,000 hours on this service, carrying men and materials for the Korean war.

The North Stars are flown to Japan via San Francisco and Hawaii; occasional stops—dictated by weather or fuel allowances—are made at Johnston, Wake, Kwajalein or Iwo Jima. The aircraft formerly used a Northern route for the outward journey, but less severe headwinds are now encountered. Ground crews of the R.C.A.F., stationed at a number of the stopping-points, change their stations every six weeks.

Design for Maintenance

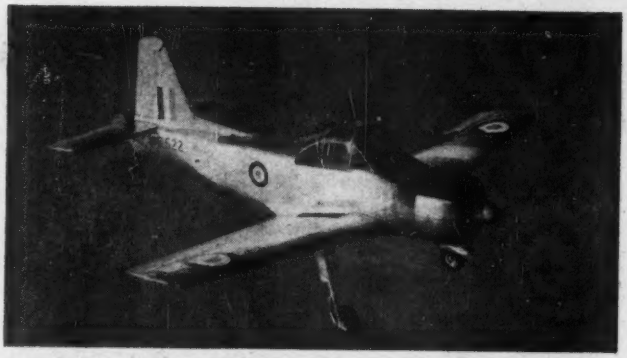
THE maintenance of future aircraft for the R.A.F. will be considerably simplified by new decisions taken by the Air Ministry which, broadly speaking, will demand the incorporation of "planned-servicing" requirements from the drawing-board stage.

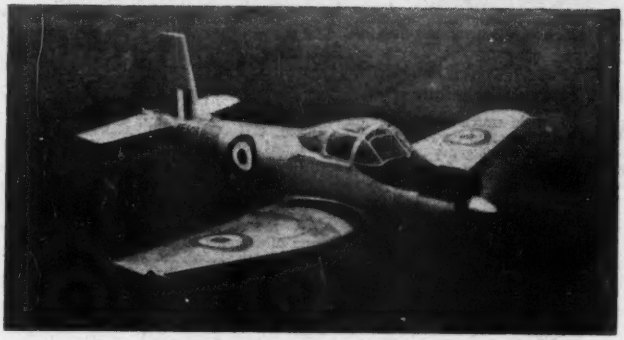
Specifications for the new fighters, for example, will henceforward stipulate maximum times to complete the various tasks which must be undertaken when the fighter lands to make it ready to take-off on another sortie. These tasks include refuelling, rearming, replenishment of the oxygen supply and so on. In the past no specific maximum times were laid down for these operations.

With the object of ensuring adequate attention being given to the maintenance aspects of aircraft design, it has also been arranged that specialist officers of the R.A.F. Technical Branch at the Air Ministry, together with officers and senior N.C.O.s from the R.A.F. Central Servicing Development Establishment, shall be consulted at all stages in the development of new aircraft built for the R.A.F. This is to ensure that components or equipment needing regular inspection and attention are not placed in positions where they are difficult to reach and, consequently, liable to delay the aircraft's return to a state of operational readiness.

Serious servicing "snags" in a projected new aircraft will thus be discovered and remedied while the type is still in the drawing-board or "mock-up" stages before even prototypes are built. When prototypes have been completed they are subject to a detailed "servicing appraisal." During this appraisal experienced N.C.O.s of different trades examine the aircraft from the standpoint of servicing in their own particular trade. Their individual reports are then discussed and co-ordinated, and when possible any minor alterations recommended are incorporated in the production aircraft.

No matter how good the flying performance of a new bomber or fighter, it cannot be a fully effective aircraft in war if it must spend long periods on the ground between operations being overhauled. The new system should help to provide aircraft which are equally efficient from both aspects.





SIDE-BY-SIDE: These photographs, showing the Percival P.56 (upper picture) and Handley Page (Reading) H.P.R.2 display, comparatively, the external features of these Cheetah-powered basic trainer prototypes. Immediately apparent distinguishing features are the larger, curved-top fin of the Percival, and its straight leading-edge. The H.P.R.2's tailwheel-position (well forward) is another useful clue for the spotter. Both types may use the Alvis Leonides as an alternative power-plant. The Percival P.56 is now flying without the dorsal fin shown above.

New Director of Plans

AIR COMMODORE J. H. EDWARDES-JONES, C.B.E., D.F.C., A.F.C., who has been attending the 1950 course at the Imperial Defence College, will become Director of Plans at the Air Ministry, under the Assistant Chief of the Air Staff (Policy), in January. He was Deputy Director of Plans from November, 1945, until January, 1948, and afterwards commanded the Tactics branch of the Central Fighter Establishment for two years. Born in August, 1905, at Wimbledon, Surrey, and educated at King's College School, Wimbledon, Brighton College, and Pembroke College, Cambridge, A. Cdre. Edwardes-Jones was commissioned into the R.A.F. in 1926.

At the outbreak of the war he commanded No. 213 Fighter Squadron, in which he won the D.F.C. in 1940. Afterwards he served with various operational training units and commanded R.A.F. Station Exeter, until September, 1942, when he was given command of No. 323 Wing, which subsequently became part of the North West African Air Force, the Headquarters staff of which he joined in the following year.

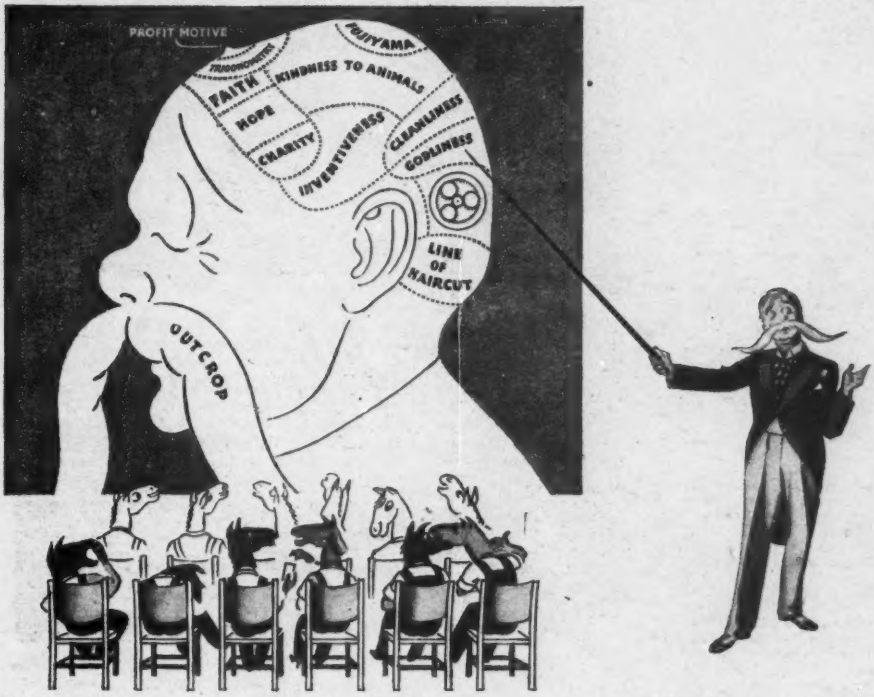
He continued to be employed in the Mediterranean theatre of operations until the end of the war, being appointed A.O.C., No. 210 Group, Mediterranean Allied Air Forces, in July, 1944, and Senior Air Staff Officer at H.Q., Mediterranean Allied Coastal Air Forces, later in that year. In the following year he was Deputy Director of Operations at H.Q., Mediterranean Allied Air Forces, and Senior Air Staff Officer at R.A.F. Mediterranean and Middle East Headquarters before being posted to the Air Ministry as Deputy Director of Plans.

A.T.C. Boxing Championships

SEMI-FINALS are now under way for the annual A.T.C. Boxing Championships, to be held at the Albert Hall on January 22nd. This event, to be patronized by distinguished past and present members of the R.A.F., will mark the tenth anniversary of the Corps.

Medals and trophies will be presented at the end of the contests to 24 cadets, divided according to age and weight, all of whom will have fought in unit, wing, group, inter-group and area contests. Seven of the bouts will already have been decided during the afternoon of January 22nd at the Metropolitan Police Gymnasium, Scotland Yard.

The Northern and Southern finals are to be decided, respectively, in Manchester and Rhyl on January 6th. Tickets for the Royal Albert Hall contests may be obtained at the box office or the usual agencies.



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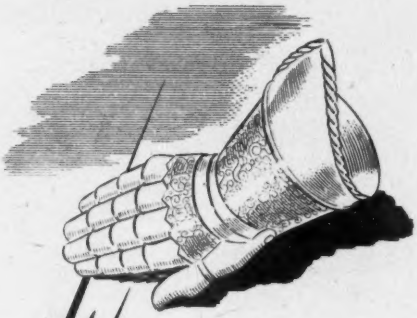

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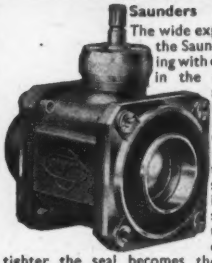

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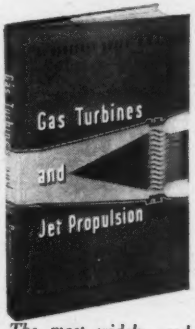

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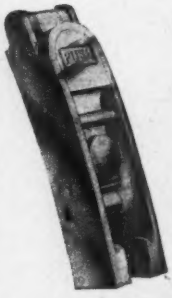

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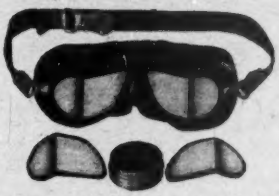

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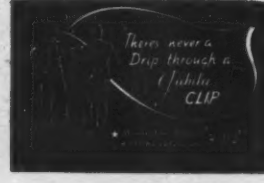

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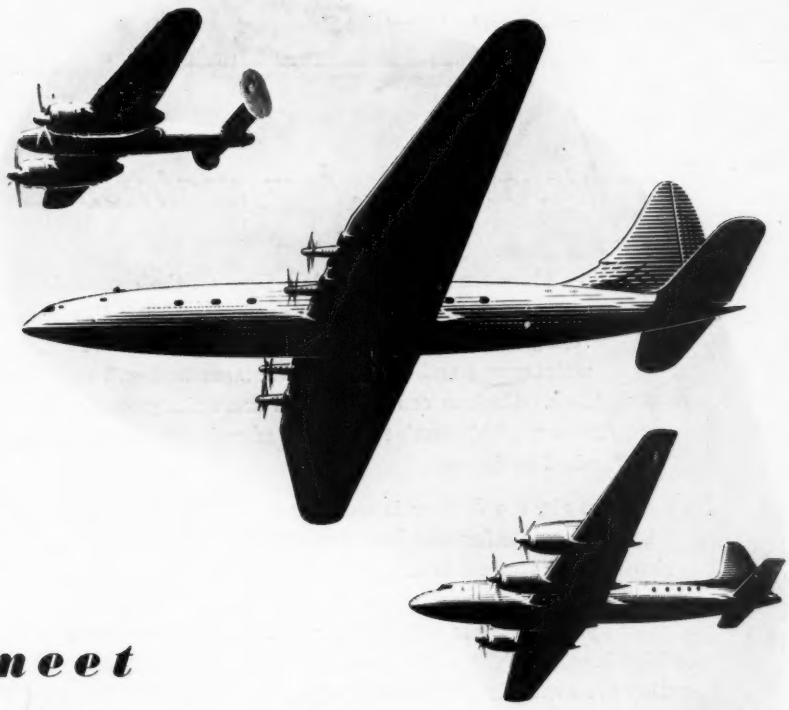

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